

*Volume 7 Issue 1*  
*January 2017*



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I am always honored to be the editor in chief of TOJNED. Many persons gave their valuable contributions for this issue.

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The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJNED.

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**January 01, 2017**

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# **A CHARACTERISTIC WAY OF CONTINUING PROFESSIONAL EDUCATION OF THE PRIMARY AND SECONDARY SCHOOL TEACHERS IN CHINA: THE PRACTICE AND ENLIGHTENMENT FROM THE NATIONAL TEACHER TRAINING PROGRAM**

Huaying BAO

Research and Development Center of Continuing Education,  
Beijing Normal University (China)

Wenfeng HUANG

School of Continuing Education and Teacher Training,  
Beijing Normal University (China)

Yuanxia LIU

Research and Development Center of Continuing Education,  
Beijing Normal University (China)

Lan XIA

School of Continuing Education and Teacher Training,  
Beijing Normal University (China)

Faxin WANG

Research and Development Center of Continuing Education,  
Beijing Normal University (China)

Shuo WANG

Institute of International and Comparative Education  
Beijing Normal University (China)  
wangshuo@mail.bnu.edu.cn

## **ABSTRACT**

In China, the unbalanced professional competencies of K-12 school teachers in the urban and rural areas seriously influence the equitable and healthy development of basic education. To improve the overall quality of the kindergartens, primary and secondary school teachers, National Teacher Training Program (NTTP) for the teachers has been implemented by Chinese government since 2010. Among 2010 and 2014, more than 7 million K-12 school teachers were trained through NTTP, who mostly were from the midwest, rural regions, and the subject areas of short teacher supply. By the strong support and leadership of the governments, the program integrated the training resources from colleges, K-12 schools and training institutions (enterprises) effectively. In addition, NTTP significantly promoted the innovation of training patterns and the improvement of professionalism in teacher training. The comprehensive supervision policies and the combined evaluation methods of NTTP also provided good references to ensure the effectiveness and pertinence of large-scale training. The practice of NTTP has traced a leading and characteristic way of professional education, which also has the important enlightenment for the continuing development of the other specialized field in China.

## **INTRODUCTION**

According to statistics, the number of full-time teachers of K-12 schools in China reached 13 million in 2014 (Ministry of Education of China, 2015). The professional level of such a large contingent of teachers is the fundamental guarantee to ensure the quality of Chinese basic education. However, although the buildup of the teacher team has made great progress through teacher training and other ways in recent years, the overall quality of the teacher team has not fully met the needs of the reform and development of education in the new age.



Meanwhile, the quality of the K-12 teachers has a significant gap between in the urban and rural areas and also in the eastern and midwest provinces, because of the unbalanced regional development. In 2010, the Outline of the National Plan for Mid-to-Long Term Education Reform and Development (2010-2020) (Outline of National Plan for Education) was promulgated and started to be implemented in China. It put forward a strategic objective, to create a high-quality professional teacher team with noble ethics, proficient skills, reasonable structure and energetic spirits (State Council of China, 2010). To improve teacher's quality and promote educational equity, the National Teacher Training Program (NTTP) for the kindergarten, primary and secondary school teachers has been implemented by Ministry of Education and Ministry of Finance of China since 2010.

NTTP mainly includes the four types of branch programs: the Midwest Rural Backbone Teacher Training, the Primary and Secondary School Exemplary Teacher Training, the Kindergarten Teacher Training, and the Primary and Secondary School Headmasters Training. From 2010 to 2014, the Chinese central government financed 6.4 billion RMB for NTTP. The continuous input from the central government led to the continuous growth of the provincial funds of teacher training. The provincial governments invested a total of 5.9 billion RMB during the five-year period. Through NTTP, more than 7 million teachers of K-12 schools were trained, among which the rural teachers accounted for 96.4%. It almost fully covered that of the compulsory education schools and kindergartens in central and western rural area of China [3]. The implementation of NTTP has played an important promoting, leading and exemplary role in the overall teacher training and also has caused an important social impact in China.

### **PRACTISE CHARACTERISTICS OF NTTP**

NTTP aims to make example of leading in teachers' training, provide timely help and promote education reform; focuses on the support to the teacher training of the midwest, rural regions, and the subject area of short teacher supply. Along with the program's launching, the training mechanism and patterns have been continuously innovated and the high-quality teacher's training resources have been constructed. Such organized large-scale training practice reflects following prominent features.

#### ***Meeting the needs of basic education of China closely***

According to the principle of "training for the actual requirements of teacher", NTTP put forth efforts on meeting the teachers' individual needs of professional development in both the training content and training organizing form. In the training content, the implement of the new curriculum of basic education and improvement of the teaching skills of teachers are mainly considered. Based on the Training Curriculum Standards of NTTP, the gradual training courses are designed. These courses take distinct themes and typical cases as carrier and closely combine with the real teaching situation of school education. Among all the NTTP training courses, the percentage of the practical courses is required to be more than 50%. In the training organizing form, The targeted training were carried out for the teachers, depending on their different requirements and individual characteristics, such as categories, levels, working positions, subjects as well as professional development stages.

#### ***Focusing on the training of teachers in the Midwest provinces, rural areas and shortage subject areas***

Through NTTP, 6.4 million rural teachers of the Midwest areas almost had been trained during 2010 to 2014. Only in 2014, the number of rural teachers trained through NTTP exceeded 2 million, accounting for more than 96% of that of total teachers trained (Institute of Chinese Education Policy of Beijing Normal University, 2015). Through the training in the past 5 years, the overall quality of rural teachers has been promoted significantly. In addition, NTTP also focused on the teachers training of shortage subject field such as music, sports, art, preschool education and special education in the rural schools. Since a serious lack of such professional teachers,

the courses in these subject areas are often taught by the part-time and nonprofessional staffs. The slanted support of NTTP to the areas contributes to boost the professional skill and capability of teachers, and then to cultivate students' comprehensive quality. Based on the practice of NTTP, General Office of the State Council of China published the Support Plan to the Village Teachers (2015-2020) (Support Plan) in June 2015. With a series of systematic and integrated measures, the implementation of the new plan will benefit the 3.3 million village teachers from the central schools of towns and from the village schools. According to the plan, the village teachers would receive diversified training, including the education of teachers' ethics, the application of information technology in daily teaching, etc., in the 5 years (General Office of the State Council of China, 2015). The implementation of NTTP and Support Plan will effectively narrow the education gap between the urban and rural areas of China.

### ***Innovating the teacher training patterns***

In order to resolve the current problems of teacher training, including the contradiction of working and learning, the lack of continuous support for professional growth and the difficulty in putting the distance training into effect, the patterns of teacher training have been continuously innovated. The special patterns, such as combining the short-term centralized training with long-term school-based training, online training with offline training, are widely adopted in the implementation of NTTP.

#### Replacement of Off-the-job Training

In the implementation of this mode, executive departments of education organize the senior students in normal colleges to practice in the K-12 schools, and the teaching positions of the backbone teachers in schools can be replaced. And then these backbone teachers will receive the full-time training for a period of 4-6 months in colleges and practice in other higher quality schools. By deeply combining the centralized training in colleges and the practice of "Shadow teacher" in high-quality schools for the backbone teachers with the working practice of students from normal colleges, this training mode can offer an opportunity of long-term off-the-job training to the teachers especially in schools of rural area.

#### Teacher Workshop Training

In the mode, the "Seed Teacher" is cultivated by centralized face-to-face training and selected. Then the "Seed Teacher", as a host, builds the Teacher Workshop. This mode combines the centralized training for the workshop hosts with the network training for the workshop participants. The continuous training of the more teachers can be supported through this way.

#### Network-based and School-based Integrated Training

In the mode, the network-based training is combined with the school-based training, and the blended learning of online and offline is applied. Through the mode, the unified network-based community, including "personal network space", "workshop", "school community" and "regional community", is designed and operated. The mode is beneficial to promote the effective integration of teaching research and training, establish a good running mechanism and achieve normalization of teacher training.

Since 2015, NTTP has focused on supporting the village teachers from countryside of the midwest provinces of China. The professional training of the village teachers is carried out through various methods, such as replacement of off-the-job training, professional training to the countryside delivered directly by experts, network-based training, short-term centralized training and school-based training and so on.

### **ENLIGHTMENT of NTTP PRACTICE**

The implementation of NTTP brings about the profound change on the organization mode, management style and patterns of teacher training in China. Some meaningful revelations of the NTTP practice are summarized.

***Promotion dominantly by governments is the elementary guarantee of implementation of the training program***

The teacher training of the K-12 schools possesses an attribute of quasi-public goods (Cao, 2013), so the establishment of government-led teacher training management system and the policy guarantee is needed accordingly. Outline of National Plan for Education put forward the demand: “It is needed to improve the training systems. The teacher training funds would be included in the government budget. The overall training of teachers should be implemented in five years as a cycle” [2]. In 2011, Ministry of Education of China requested that the post-training time of in-service teachers should be not less than 360 class hours accumulatively every 5 years (Ministry of Education of China, 2011). Under the background of these policies, NTTP, as a national training program financed by special funds of the central government, has been promoted dominantly by the government. The impetus role of the government is almost reflected in all the aspects: establishment of training system, selection of institutions, fund investment, organization and management, supervision and evaluation of projects. Based on this, the smooth implementation of the large-scale training program could be ensured in China.

***Effective integration and sharing of excellent training resources is the important condition of the training program***

Teacher training is a type of resource-dependent service. The implementation of NTTP needs adequate excellent training resources as support. In 2012, more than 100 experts, organized by Ministry of Education of China, have developed the Training Curriculum Standards of NTTP in 67 disciplines and fields. The standards have been promulgated and applied to the training program effectively. Based on that, the national training curriculum standards for compulsory education teacher are currently under developments. In addition, 90 and 33 institutions, for the exemplary centralized training and for the distance training respectively, were confirmed after the review of education experts. These institutions, with the normal universities as main body, include the comprehensive universities, the high-quality primary and secondary schools as well as the specialized organizations (enterprises) for teacher training. Until 2013, 1500 training experts had been selected to list in the specialist database of NTTP by three batches. These experts were mainly from colleges and universities, professional training institutions, K-12 schools. Among of them, there were 788 outstanding front-line teachers, accounted for more than 50% of the total. Meanwhile, the training resources database of NTTP had been established. More than 1500 excellent courses from the database were recommended as the resources for the integrated training (Executive Office of National Teacher Training Program, 2015). Through NTTP, the training resources from all the participating parties, including colleges, K-12 schools and training institutions (enterprises), are effectively integrated. With the implementation of NTTP, the more talents have been driven to participate in the research of the basic education and teachers’ professional development. Thus, the establishment of the whole teacher training system of China has been boosted.

***Long-term and full-cycle supervision and evaluation to the training projects is the key factor to ensure the effectiveness and pertinence of the training program***

Firstly, NTTP is supervised through the promulgation of various policies and standards. Secondly, the full-cycle process of implementation is assessed by several ways, such as Big data evaluation, network-based anonymous evaluation from the trained teachers; spot-check evaluation from experts and evaluation from the third-party. Consequently, the pertinence and effectiveness of NTTP has been promoted. From 2010 to 2014, the satisfaction ratio of trained teachers through the statistics of the network-based anonymous evaluation had raised year by year. For example, the satisfaction ratio of three types of program in 2013, the Midwest Rural Backbone Teacher

Training, the Primary and Secondary School Exemplary Teacher Training and the Kindergarten Teacher Training, reached 88.1%, 91.3% and 92.0%, respectively (Executive Office of National Teacher Training Program, 2015). As an important reference, the evaluation results are used for the decisions about financial reward and supplement, institutions selection and projects undertaking. So the mechanism of the “survival of the fittest” has been formed and the quality of training has been improved effectively. Furthermore, the design and establishment of the long-term evaluation mechanism is under active exploration and construction, although it is considered as a very difficult issue.

## CONCLUSIONS

During the normalization process of teachers training of kindergartens, primary and secondary schools in China, NTTP has taken effect and will continuously take effect as an important benchmark and model. Through the implementation of NTTP, both the management levels of training project and the professionalism in teacher training have been improved remarkably. Meanwhile, the efficient training system in China has been building. The practice of the special training program has traced a characteristic and leading way of professional education of the K-12 school teachers in China. The implementation of NTTP not only has a profound impact on the overall teacher training, but also has significant enlightenment and reference to the continuing professional development of other specialized fields.

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# A COMPARATIVE STUDY ON EDUCATIONAL SUPPORT FOR STUDENTS WITH LEARNING DISABILITIES BETWEEN JAPAN AND THE U.S.

Noboru Sakai, Ph.D.  
The University of Queensland  
noboru.sakai@uqconnect.edu.au

## ABSTRACT

Learning disabilities (LD) are one of the essential issues in education, and also a very difficult challenge to overcome it in practice. This study compares to Japan and the U.S. as an example case of a country where LD support is still early stage and relatively advanced respectively, with the supports based on three different level of organizations: schools, communities, and nationwide. Supports for LD students may be in a challenging stage, but educational support based on their educational culture will result in a meaningful outcomes for their future support systems.

**Keywords.** Learning disorder, Dyslexia, Dyscalculia, Japan, the U.S., comparative study

## 1. INTRODUCTION

In current Japanese society, Japanese schools face significantly serious educational problems such as bullying, truancy, decreasing the students' motivation for study, and so forth. Japanese schools required to resolve these problems (Kitagawa, 2003). Among these educational problems, learning disabilities have been recognized one of the biggest problems to manage class and instruction (Morinaga, 2002). However, learning disabilities are not a new disorder. In the U.S., clinicians and researchers started to research people with learning difficulties in 1920s. During 1920 to 1960, researchers started to find new instructional methods for people with learning disabilities to learn. After this period, learning disabilities became a significant problem in formal situation, so from this period, the government started to implement several educational policies for students with learning disabilities (Hallahan & Mercer, 2002). In Japan, during 1980s, many cases that students could not read letters were reported and many educators were interested in learning disabilities (Morinaga, 2002). Recently, many Japanese educators understand the importance of educational support for students with learning disabilities and they try to implement some educational support (Eda & Ono, 2004). Students with learning disabilities can receive educational support from several agencies; however, comparing Japan and the United States, the policies of educational support are similar in certain aspects but different by each agency level such as schools, nongovernmental organizations (NGOs), and the government.

## 2. LEARNING DISABILITIES: A BRIEF SUMMARY

Learning disabilities are educational problems in specific educational fields that students exhibit in a class. In general, students with learning disabilities have the same or higher average intelligence as other students, so other than their problematic academic areas, they can keep up with lectures without problems (Kemp, et al., 2016). Concerning learning disabilities, there are many aspects on which almost all professionals agree; however, the definition of learning disabilities is not the same at the international level. Learning disabilities are defined by many agencies. The context of each definition is quite similar, but differences can be found. For example, In Japan, the Ministry of Education (1999) defined learning disabilities as

...various conditions, fundamentally without delay in overall intellectual development, manifested by significant difficulties in acquisition and using specific abilities of hearing, speaking, reading, writing, calculating, or reasoning. Learning disabilities is presumed to be due to central nervous system dysfunction as a causal background, while disorders, such as impaired vision, hearing loss, mental retardation and emotional disturbances, or environmental factors are not direct causes of learning disabilities (as cited by Hara, 2002a, p7).

In the U.S. learning disabilities were defined by the National Joint Committee on Learning Disabilities (NJCLD) in 1990:

...a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the life span. Problems in self-regulatory behaviors, social perception, and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability.

Although learning disabilities may occur concomitantly with other [disabling] conditions (for example, sensory impairment . . . serious emotional disturbance) or with extrinsic influences (such as cultural differences, insufficient or inappropriate instruction), they are not the result of these conditions or influences.

These definitions are widely used to understand learning disabilities. There are several types of learning disabilities. Dyslexia is a reading disability (Kemp, et al., 2016). Dyslexia is the most common learning disability because most of the students with learning disabilities suffer from dyslexia (Hara, 2002b). According to Davis & Braun (1994/2004), students with dyslexia look at letters as various shapes. Some students look at letters as three-dimensional figures, and others look at these as similar confusing figures. Figure 1 illustrates how students with learning disabilities cognate letters. In this case, CAT is used as an example. For these students, CAT is seen not only in correct order and direction but also letters with errors. Also, Sometimes dyslexia causes other learning disabilities such as dysgraphia and dyscalculia (not all the time, and sometimes these learning disabilities exist without dyslexia). Dysgraphia is a writing disability (Kemp, et al., 2016). It is quite common that students with dysgraphia write unbalanced letters, or sometimes are not being able to cognize the letter themselves (Davis & Braun, 1994/2004). Dyscalculia is an arithmetic disability (Kemp, et al., 2016) Students with dyscalculia exhibit problems, in addition, subtraction, multiplication, and division (Davis & Braun, 1994/2004).

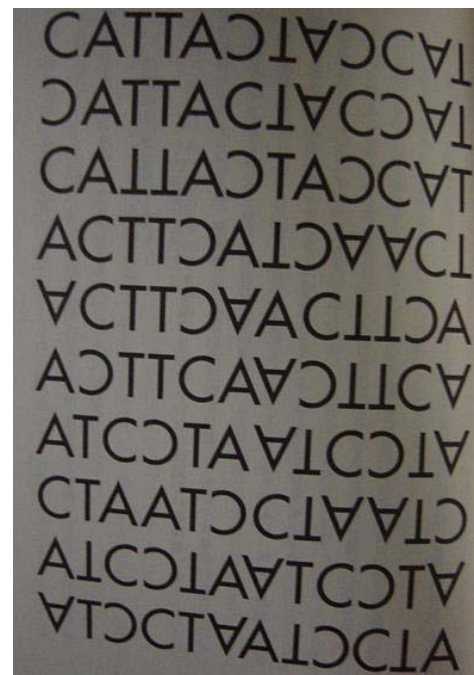
### 3. SCHOOL SUPPORTS

For students with learning disabilities, educational support by the school is the most direct, and affects their lives. Since students spend most of their time at a school, the school level support is the most essential support; therefore, the school support is quite important for the students to overcome both primary effects (difficulties in a class room) and secondly effects (difficulties outside a class room such as communication problems and bullying) from leaning disabilities.

In general, children with learning disabilities encounter their learning problems at school. Before they entered school, they have been able to understand things through their unique methods. However, in a school, teachers use specific methods to teach subjects, and students need to understand lectures with teachers' methods. In many cases, the teachers' methods and students' original methods are different, so students face academic problems at school. Moreover, if teachers do not have knowledge of learning disabilities, sometimes they regard students with learning disabilities as lazy students. In this case, students' hardships are extremely increased (Davis & Braun, 1994/2004).

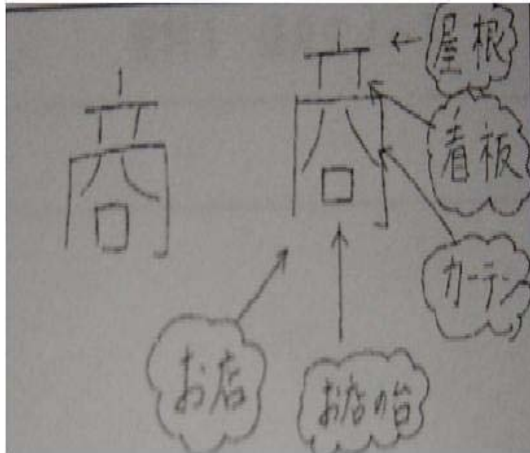
If students suffer from learning disabilities, they exhibit academic difficulties in class; some schools try to support these students. Since teachers device the methods of instruction, student can understand the lectures. For example, the Nagano Prefectural Board of Education (Nagano PBE) (2003b) reports one case study. In one elementary school in Japan, the teacher came across the student suffering from dysplasia. His name is Akira. Akira is an active student, but he is a stammer, so he hesitated to speak. In addition, he had a difficulty understanding the contexts of teacher's and friends' utterances. Moreover, he had difficulties understanding the directions and methods teacher showed. Because of dyslexia, it was also quite difficult for him to memorize *Hiragana* (Japanese letters) and *Kanji* (Chinese characters). To support him, the teacher has taught *Kanji* as a picture. For instance, to teach 商 (pronouncing Shou, the meaning of commerce), the teacher taught 商 as a picture of a shop. Figure 2 describes the picture that teacher used in class. According to the figure 2, the top of 商 is a roof, the middle part of 商 is a signboard, and internal part is a curtain and a table. In addition, the teacher has tried to review again and again because he was not good at memorizing the contents of lectures. Two years later, when he became a third-year student, he tried to study passionately and increased the number of comments in the classroom. In addition, he positively tried to

Figure 1, The vision of people with dyslexia (Example of CAT)



(Source: Davis & Braun, 1994/2004, p123)

Figure 2, Example of *kanji* as a picture,



(Source: Nagano PBE, 2003b)

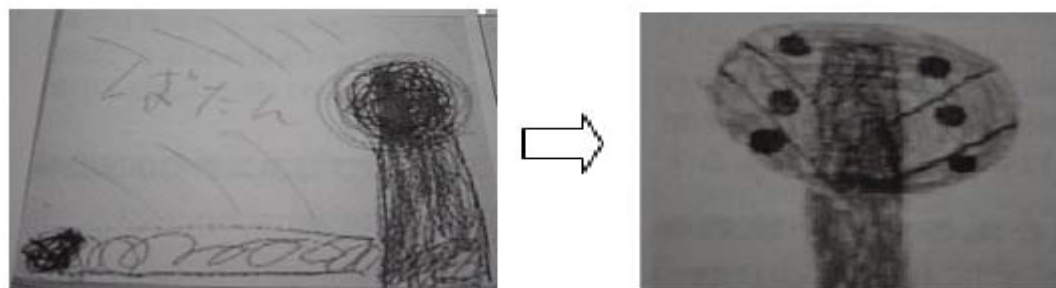
do various activities.

In case of the U.S., some universities have a learning disabilities center to support students. In general, when students can not understand lectures or receive credits, students go to learning disabilities center to listen to advice. In a learning disability center, professionals detect student's abilities, and if the student is diagnosed as learning disabilities, the student can receive special treatment such as providing printed materials instead of oral lectures, or recording the questions on examination because if not, students with learning disabilities face unfair situations regarding the class and grade, complying with Act 504 (e.g., St. Petersburg College, 2007).

Moreover, sometimes students with learning disabilities face not only academic difficulties but also secondly difficulties. Therefore, some schools try to resolve secondly problems. For example, Yuki is a first-year student in an elementary school. Since she

had difficulties communicating with her friends, she refused to go to school. Therefore, her teacher went to her house and talked with her and her parents. After the teacher visited her house, she has been able to start to go to a *Hoken-room*, where school nurse stays to help students who are injured from school activities. In Japan, sometimes students go to Hoken-room instead of a classroom because they have some reasons that prevent them from going to the class room especially bullying. In the Hoken-room, she received special treatment. At the same time, parents, teachers and specialists such as psychiatrists and psychologists closely communicated to support her appropriately. One day, when she participated in a school sports festival, she became nervous. However, her mother and teachers helped her carefully, she could relax during participation, and then, at last, she could take part in the school sports festival. Figure 3 shows the pictures she wrote before and after the school sports festival. Before the school festival, she had written a tree falling down because she did not have confidence. However, she has written a standing tree after the school sports festival. The change of picture means she could restore confidence from taking part in the school sports festival. After school sports festival, the teacher has continued to try to support Yuki kindly. As a result, one morning in December, she started to go to a classroom by herself, and she could spend time in the classroom even though sometimes she faced communication difficulties (Nagano PBE, 2003a).

Figure 3, the pictures she wrote before/after the school sports festival



(Source, Nagano PEB, 2003a)

As the examples are shown previously, both some Japanese and American schools try to support students with learning disabilities enthusiastically; however, in reality, the ratio of students who receive special treatment is quite different between Japan and the U.S. The differences are quite obvious about 10 years ago. According to Morinaga (2002), on the one hand, the ten percent of American students can receive special treatments; on the other hand, in Japan, only one percent of students can receive special treatment. One example shows this great difference between Japan and the U.S. Ryo is a 3rd-year student in a Junior high school. Now she goes to school

in Japan. When she was the 5th year student in an elementary school, she moved to the U.S. because of her father's job. In the American school, she had hardly improved her English ability even though she had tried to study hard. Therefore, teachers suggested receiving a medical examination. After finished medical examination, she was diagnosed with dyslexia. After that, she could receive special treatment from the school such as the admission of special education classes. When she became the first year student of the junior high school, she returned back to Japan. In Japan, her parents asked the board of education to provide special education. When the parents meet the staff of board of education, they said that they told her case to the school; however, they did not, and then the parents requested the school dean to provide help, yet the school did not support at all because the school argued all students should be treated equally, so the teachers cannot treat her as a special case (Shinagawa, 2004).

In the present, as the People with Developmental Disabled Support Law was passed in 2005, and the special support education schools have developed since 2008 in Tokyo metropolitan area, the number of students who actually can receive special treatments based on their learning problems has been increased to a certain extent. However, as in particular the casual exchanges by parents and sometimes teachers (i.e., sources are not an academic literature, but from the discourse under people's active communication, which is likely to reflect their natural responses and understanding) show, the schools that can offer special treatment are still quite limited: regional differences are tremendous, and students without emotional disorders such ADHD or intellectual disability tends to be neglected of their special needs. Therefore, LD support is a challenging or even immature stage where further advancement is required.

#### 4. ORGANIZATIONAL LEVEL SUPPORTS

To support students with learning disabilities, many NGOs have been established and the members of the organizations support students with learning disabilities with various policies. Some NGOs provide special education for the students, and other NGOs suggest educational policies to the government.

In the U.S. many NGOs have been established and they provide unique educational programs to students with learning disabilities. One example is Davis Dyslexia Association International (DDAI). DDAI provides a unique method called the Symbol-Master-Method, which educators use symbols to educate students with learning disabilities to teach letters. This method can be applied to numbers, symbols, and so forth. Therefore, this method can educate students who suffer from various types of learning disabilities. For example, figure 4 shows the case study of the Symbol-Master-Method. In this case, an educator taught fractions. Numerals have replaced the dots. Therefore, students could understand fractions without reading numerals. With the Symbol-Master-Method, DDAI has supported more than 1,500 children and adults with learning disabilities (Braun & Davis, 1994/2004). Another example is the NJCLD.

Figure 4, The Symbol-Master-Method to understand fractions



(Source: Braun & Davis, 1994/2004)

The NJCLD, which consists of 11 learning disability organizations, was established in 1975. The purpose of the NJCLD is to provide sufficient welfare for the students with learning disabilities. Since the NJCLD was established, they have tried to inform educational and governmental professionals about issues regarding learning disabilities (LD Online, 2015). The NJCLD has also defined the term learning disabilities. The NJCLD revised the definition of learning disabilities several times (Hallahan & Mercer, 2002).

In Japan, the Japan Academy of Learning Disabilities (JALD) is one of the biggest organizations that research learning disabilities. JALD consists of specialists: professors, clinical psychologists, educators, and teachers. The purposes of JALD are to improve situations around students with learning disabilities and research new methods to educate them (JALD, 2016). In addition, other than research organizations, *Kazokukai* (parents' organization) play important roles. A *Kazokukai* consists of parents of students with learning disabilities, and a *Kazokukai* widely distributes information on learning disabilities, makes presentations, and request the government to improve the educational environment for students with learning disabilities (LD keyaki, 2013). Moreover, each prefectural *Kazokukai* communicates and exchanges information to support the early detection of learning disabilities and (Japan LD parents' Association, 2009). For example, the Tokyo LD Parents' Association (Tokyo LDPA) tried to request the Tokyo Metropolitan Board of Education (Tokyo MBE) to improve the educational environment for students with learning disabilities. On September 21, 2001, the Tokyo



LDPA and the Tokyo MBE had met. In this session, the Tokyo LDPA request the Tokyo MBE to improve educational support and environment for students with learning disabilities such as teacher education, allocation of specialists, conducting special support in class and examination, and so forth. About these requests, the Tokyo MBE gave positive answers to the requests from the Tokyo LDPA. For instance, when the Tokyo LDPA asked to educate teachers to understand and teach students with learning disabilities appropriately, the Tokyo MBE answered that the Tokyo MBE will conduct study meetings among teachers frequently (Tokyo LDPA, 2001).

## 5. NATIONAL LEVEL SUPPORTS

The U.S. has implemented several acts that support students with learning disabilities. The Individuals with Disabilities Education Act (IDEA) offers special education for students with learning disabilities who are under 22. The IDEA provides Free Appropriate Public Education (FAPE) and the Individualized Education Program (IEP) (National Center for Learning Disabilities [NCLD], 2014). FAPE realizes free educational service for students with learning disabilities, and because of the IEP, these students can receive special education based on their needs (GreatSchools Staff, 2015). Section 504 of the Rehabilitation Act ensures equal opportunities for students with learning disabilities to access educational programs. The Americans with Disabilities Act (ADA) prevents students with learning disabilities from discrimination in the operation of public and private agencies. Because of these laws, students with learning disabilities can receive equal opportunities to receive educational programs without discriminations. In addition, regarding their courses and examinations, they can receive accommodations based on their conditions (NCLD, 2014).

In addition, the U.S. has implemented the No Child Left Behind (NCLB) act in which one of the prospect supports students with learning disabilities. The NCLB is an educational act proposed by George. W. Bush, the President of the U.S., to improve the quality of education. This act requires standardized exams for all students in every school (Neil, at el., 2004). George W Bush (Strauss (2015) re-examines his speech with a whole exhibition of Bush's 2002 speech and this paper refer to it) mentioned that many children cannot catch up with standard education; therefore, educational systems should be changed to resolve this educational failing. The prospective advantages of the NCLB are to improve students' performance, invest federal budget to improve schools and teacher quality, increase flexibility, and inform parents. Therefore children can be educated without failure. On the other hand, some educators argue that the NCLB decreases the quality of education and equity. Since the NCLB is based on testing, schools will try to only increase the scores of standardized tests, and then schools will not provide high-quality education but just focus on preparing tests. In addition, the standardized exams can not measure students' ability correctly because the quality of the tests is poor. Therefore, the NCLB might fail as an educational policy (Neil, at el., 2004). According to the NCLD (2014), since the NCLB requires annual tests, students with learning disabilities can be detected in early stage, so students with learning disabilities can receive special education appropriately. In addition, the NCLB provides teachers who have special knowledge or skills with learning disabilities, so the students can receive a high quality education. Of course, students with learning disabilities can receive proper accommodation on their tests; therefore, these students do not face discrimination.

In Japan, the Japanese government has tried to start to implement policies that support students with learning disabilities. In January, 2004, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2004) announced guidelines to support people with learning disabilities. These guidelines provide information for educational administrations, schools, specialists, and parents and students. Furthermore, on December 3, 2004, the People with Developmental Disabilities Support Law was accepted by the senior cabinet. The purpose of this law is to extend the social welfare services for learning disabilities that had not been supported by the previous laws. Under the law, the national and prefectural governments must support learning disabilities. According to the context of this law, support centers for people who suffer from developmental disabilities will be constructed in each prefecture. In addition, this law includes implementation of early detection of learning disabilities with infant or school diagnoses, preparation of professional institutions, and employment support. The People with Developmental Disabled Support Law was implemented in 2005, which further re-written in 2015. As a practical example, the National Center Test for University, which any people who want to go a national university are required and can be optionally used for many private universities and/or some qualifications acquiring in Japan, has practiced special consideration since 2010 (National Center for University Entrance Examinations, 2016). Still an early developing stage, but these policies are expected to improve the social welfare of students with learning disabilities.

Comparing Japan and the U.S., the policies and legislation of the U.S. government are much more advanced than the policies and legislation of Japanese government. However, the Japanese government has started to support students with learning disabilities such as legislating special support law, and it can be expected that the

Japanese government will reinforce social welfare for students with learning disabilities as the U.S. government have already implemented.

## 6. CONCLUSION

There are several agencies that try to support students with learning disabilities in both Japan and the U.S. In the both countries, schools conduct educational support for these students; however, compared to the U.S., many Japanese schools do not conduct any special support for students with learning disabilities because of the policy of equal treatment for all students. Moreover, many NGOs also try to support students with learning disabilities to provide special education or suggest new policies for both parents and government. At the national level, the governments, in both Japanese and the U.S., are important agencies. Since several acts that assure the rights of these students are conducted, these students can receive equal educational opportunities in the U.S. In Japan, systems that support students with learning disabilities are being constructed; therefore, educational opportunities for these students have been increased. Because of these agencies' efforts, educational support systems have been advanced. Shortly, it can be expected that barrier-free education will have been completed.

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## AN INVESTIGATION OF THE CONVENIENCE OF CARTOON FILMS IN TERMS OF DEVELOPMENTAL LEVELS OF PRE-SCHOOL CHILDREN\*

Fulya ZORLU<sup>1</sup>, Erhan YEŞİLYURT<sup>2</sup>, Özlem KORAY<sup>3</sup>, Bahriye GÜNGÖR<sup>4</sup>, Elif TOM<sup>5</sup>

<sup>1</sup>Department of Curriculum And Instruction Division, Faculty of Ereğli Education, Bulent Ecevit University, Turkey

<sup>2</sup>Department of Turkish Education, Faculty of Ereğli Education, Bulent Ecevit University, Turkey

<sup>3</sup>Department of Primary Science Education, Faculty of Ereğli Education, Bulent Ecevit University, Turkey

<sup>4,5</sup>Department of Pre-school Education, Faculty of Ereğli Education, Bulent Ecevit University, Turkey

<sup>1</sup>fulya.zorlu@beun.edu.tr

### ABSTRACT

The purpose of this study is investigating the convenience of cartoon films with respect to the developmental levels of pre-school children. Content analysis, one of the techniques of qualitative research, was used in the study. 10 cartoon films, five local and five foreign, showed in Turkish television channels from the year of 2014 to 2015 were investigated in terms of different points. A rubric including 20 items was used in the study and the tool was prepared by the researchers in the light of the related literature and views of the experts. Results showed that value factor was more frequently included in cartoon films while factors such as sexuality and superstitious beliefs were less likely observed. Furthermore, local cartoon films had more positive aspects in comparison with the cartoon films of foreign countries.

### INTRODUCTION

Television continues its existence in an efficient manner in many houses no matter the financial status of the families is. In this way, children also start communication with television as well as their parent because television has become a member of the family (Akbulut & Kartopu, 2004; Babaroğlu, 2015; Erjem & Çağlayandereli, 2006). Television is watched by children to know and understand the world, and it also increases the information of them and develops their imagination (Aksaçlıoğlu & Yılmaz, 2007; Kaskun & Öztunç, 1999). In the preschool period, when children seek the help of the others almost in any topic, and looks for sincere relations based on trust, and imitate almost any behavior observed, children spend much of their time watching television (Postman, 1994; Oruç, Tecim & Özyürek, 2011). In this period, children not only develop the internal entity concept but also become aware of the functions of his/her body parts and organs (Senemoğlu, 1994). Since children start to acquire science, mathematics and scientific concepts in preschool period, the activities like stimuli are extremely important (Ayvaci, 2010). Children are exposed to various television broadcast and the messages in them (Akan, 1995). The television broadcast is extremely important in the formation and development of the personality of children, acquiring basic information, skills, habits and attitudes (Başal, 2005). For this reason, television programs must have many positive influences like developing the world and language of children, for children, help their education, and guide their mental and creative activities (Karacoşkun, 2002). Cartoons rank the first among the programs watched by children on television (Güler, 2013; Güngör & Ersoy, 1995; Yörükoğlu, 1998). Cartoons develop with each passing day because children watch them with great interest and are entertained by them. Cartoons increase their efficiency every day (Arıkan, 2001; Can, 1995; Küskün & Öztunç, 2011). Cartoons are a door that is opened to the imaginary world from the real world for children (Türkmen, 2012). When the contributions of cartoons to the development and educational process of children is considered, it is possible to claim that they contribute to the learning and grasping of children at earlier ages, develop not only their emotion and intellectual world but also their aesthetics, enhance their viewpoint on life, make them learn universal and cognitive skills in a fun way, encourage them to think and make comparisons, imitate some behaviors like being helpful and make them learn new things, make the learning become more efficient by including audio-visual enhancement, and make them learn reading earlier by adopting cartoon characters to cartoon comics (Yağlı, 2013). For this reason, cartoons are among the most important factors that influence the development and education of preschool children.

The number of the studies dealing with the influence ways of television programs on preschool children in the

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literature is quite few especially in our country. The studies conducted (Cesur and Paker, 2007; Kara, 2015; Önder and Dağal, 2006) generally focus on children's programs. Mainly the negative influences of the television programs have been dealt with in the studies that investigate the influences of the cartoons on children. When the factors included in these studies are considered, the results of these studies are extremely important. The majority of the cartoons in Turkey are mostly from foreign origin (Öçal, 1997). However, in recent years, cartoons made in Turkey that have educational purposes have characteristics with which children can adopt themselves (Öktem, Sayıl & Özen, 2006). The purpose of the study, which has been designed by considering these properties, is determining whether the cartoons are suitable for the developmental stages of the preschool children or not.

*The Question of the Study*

The answer to the question "How is the suitability of the cartoons to the developmental stages of the preschool children?" has been sought in the study.

**Sub Questions**

The contents of the native and foreign cartoons that are prepared for preschool children;

- How are the cartoons when evaluated in terms of ethical development and development of values of children?
- How are the cartoons when considered in terms of including violence and character traits?
- How are the cartoons when considered in terms of including cultural elements?
- How are the cartoons when considered in terms of including superstitions?
- How are the cartoons when considered in terms of including sexual elements?

**METHODOLOGY**

**Research Design**

This study has been based on document review method. The document review covers the analysis of the written documents on the target topic of a study (Yıldırım, & Şimşek, 2013). In this context, a quantitative research model has been designed in the study.

The population of the study consists of 5 parts of 10 cartoons released on televisions in 2014-2015 period. The sample of the study consists of the 5 parts of 10 cartoons released on televisions in 2014-2015 period.

**Table 1.** The cartoons watched in the scope of the study

<b>Types of the Cartoons</b>	<b>Names of the Cartoons</b>
<b>Foreign Cartoons</b>	Ben 10
	Caillou
	Pororo
	Johnny Bravo
	Heidi
<b>Native Cartoons</b>	Niloya
	Pepee
	Folk Tales of Keloglan
	Dear Bro
	Köstebeğgiller

**Data Collection Instruments**

Between the years 2014 and 2015, an analytical rubric has been formed by receiving the viewpoints of specialists and examining the literature on the cartoons released on Turkish televisions. The rubric prepared by the authors consists of 5 criteria (cultural elements, superstitious messages, values, violent elements, including sexual elements) and 20 items based on 3 levels. During the formation of the rubrics, 2 Turkish Language and Literature teachers and 4 Preschool teachers were contacted.

The cartoons determined were examined by considering the questions of the study in terms of cultural elements, superstitious messages, values, violent elements and sexual elements. These elements were separated into sub-elements and the study was examined in the light of these criteria.

**Table 2.** The elements of the Study

The Elements	Sub-Elements
Cultural elements	Foreign Cultural elements (Christmas, birthday, Halloween) Turkish cultural elements (Music, dances, verbal messages, artistic works, food, Islamic discourses, Islamic visual messages)
Superstitious Messages	Evil Eye Bead Various Verbal Messages Fantastic Elements (Magic, spell, changing dimensions, etc.)
Values	Responsibility Justice Self confidence Sharing Solidarity Respect Love Goodness-Tolerance Peace
Violent Elements	Physical Violence Verbal Violence Psychological Violence Negative Character Properties
Sexual Elements	Sexual Connotations in Friendship Physical Sexual

### Data Analysis

The Inductive Analysis, which is one of the exploratory content analysis methods, has been used in the study. The Inductive Analysis is conducted for the purpose of revealing the underlying concepts of the data given in an encoded manner and the relations between these concepts (Miles, & Huberman, 1994). 3 parts of 10 cartoons (5 domestic-5 foreign) which were selected randomly for Inductive Analysis were determined. The cartoons were encoded by watching by the authors of the study. He encoded cartoons were evaluated with the rubric prepared. The grading in the rubric was realized as follows; if the relevant element is not included, 1 points; if given some place, 3 points; and given place mostly, 5 points. The cartoons might receive 5 points according to each item in the rubric. 5 parts of 10 native and foreign cartoons were included in the study. There were 25 parts of the cartoons in total. When the cartoons are assessed in terms of each item, they might receive 125 points at the maximum level. Considering this situation, the percentage of each elements in the cartoons was determined.

### FINDINGS

In this part, the data obtained at the end of the Inductive Analysis were given in percentages and categories.

**Table 3.** The results on including cultural and superstitious belief elements

Categories	Contents of the Item	Native Cartoons	Foreign Cartoons (25
		(25 rubric)	rubric)
		Percentage Points (%)	Percentage Points (%)
Cultural elements Including	Foreign culture	4.8	51.2
	Turkish culture	80.8	23.2
	Islamic culture	67.2	21.6

When Table 3 is examined in terms of cultural elements, it is observed that foreign cartoons have a rate of nearly 22% in terms of Islamic Culture, and 23% in terms of Turkish culture. It has been determined that the native cartoons the Turkish and Islamic culture at the highest level.

**Table 4.** The Results on Including Superstitious Elements

Categories	Contents of the Item	Native Cartoons (25 rubric)	Foreign Cartoons (25 rubric)
		Percentage Points (%)	Percentage Points (%)
Including Superstitious Belief Elements	Verbal Superstitious Elements	22.4	28.0
	Visual Superstitious Elements	32.0	25.6

When Table 4 is examined in terms of superstitious belief elements, it is observed that native and foreign cartoons have nearly equal percentages in Verbal and Visual Superstition Categories with the native cartoons.

**Table 5.** The results on values

Categories	Contents of the Item	Native Cartoons (25 rubric)	Foreign Cartoons (25 rubric)
		Percentage Points (%)	Percentage Points (%)
Values	Responsibility	74.4	56.8
	Justice	34.4	31.2
	Self confidence	74.4	51.2
	Sharing	66.4	52.0
	Solidarity	92.0	79.2
	Respect	63.2	48.8
	Love	87.2	67.2
	Goodness-Tolerance	90.4	71.2
	Peace	28.0	26.4

When Table 5 is examined in terms of values, it is observed that the native and foreign cartoons have the Goodness-Tolerance and solidarity elements in them. The Goodness-Tolerance, which is in the values category, solidarity, Love, Responsibility and Self-confidence elements are included mostly in the native cartoons. In addition, it is also observed that the native and foreign cartoons share the level in terms of Peace. On the other hand, the Peace element has a rate of 28% and included at the least level in native cartoons. The same situation is also observed in foreign cartoons with a rate of 26%.

**Table 6.** The results on including violent elements

Category	Contents of the Item	Native Cartoons (25 rubric)	Foreign Cartoons (25 rubric)
		Percentage Points (%)	Percentage Points (%)
Including Violent Elements	Physical Violence	14.4	40.0
	Verbal Violence	20.8	40.0
	Psychological Violence	17.6	38.4
	Negative Character	17.6	36.8

When Table 6 is examined in terms of Verbal Violence elements, it is observed that native cartoons have a rate of nearly 21%, and Foreign cartoons have a rate of 40% physical and verbal violent elements. It has been determined that native cartoons have Violent elements less than Foreign cartoons.

**Table 7.** The results on including sexual elements

Category	Contents of the Item	Native Cartoons (25 rubric)	Foreign Cartoons (25 rubric)
		Percentage Points (%)	Percentage Points (%)
Including Sexual Elements	Sexual Connotations in Friendship	0.0	14.4
	Physical Sexual	0.0	14.4

When Table 7 is examined in terms of Verbal Violence elements, it is observed that native cartoons do not include sexual elements, but Foreign cartoons include them. In Foreign cartoons, sexual elements are included at

a rates of 14% when Sexual Connotations in Friendship and Physical Sexual elements are considered.

## DISCUSSION

Today, television has the duty of being a window opened to the world and is located at a very important position in many houses (Yapıcı, 2006). In the formation of Popular culture, and in the spread of the values of this popular culture, the media especially the television has a very important role and it cannot be denied (Şentürk, & Turğut, 2011; Yücel, 2015). For this reason, television has many important influences in terms of the family and especially the children.

It is considered that native cartoons are more proper for our Turkish and Islamic culture. When we examine the literature in this context, it is observed that cartoons come to the forefront with teaching cultural values, and the relevant studies show similar properties (Öztekin, 2008; Türkmen, 2012; Yağlı, 2013; Yaman, Bayburtlu, Tekir and Kırman, 2015). As a culturally influential art, cartoons provide children with conscious and deliberate reference frames that will enable children sole the codes of the cultural environment in which they are living, and therefore they have the role of being an important tutor for children (Kaba, 2014; Keloğlu İşler, 2014).

It has been determined in the study that native and foreign cartoons include superstitious belief elements, and even the rate of this element is nearly close to each other. Yorulmaz (2013) conducted a study and reported that this situation could influence children in a bad manner. Especially the events that happen during perceptual processes or wrong connections that might be established among objects will become superstitious belief elements after they are strengthened in time (Ayten, & Köse, 2009). This situation is extremely important for children. According to Piaget, since preschool children are at the symbolic processes, they have difficulty in discriminating between imagination and reality (Senemoğlu, 2009). Including superstitious belief elements in cartoons might lead to unwanted situations.

It has been determined in the study that native cartoons do not include sexual elements. It is considered that this situation stems from the fact that Turkey is under the Islamic culture, and the people living in Turkey being more sensitive on the topic. In Foreign cartoons, although the rate seems low, it is considered that these elements are presented in a level that can influence children. According to the Psycho-sexual Development Theory of Freud, these children and in the Phallic Period, and are interested in sexual differences and genital organs (Aydın, 2007). Teaching the subjects that have to be given during early adulthood in early ages can lead to dangers. It is not possible for children to protect themselves from videos that include extreme violence and sexuality (İlhan and Çetinkaya, 2013). For this reason, cartoons must be organized in a manner that would not include violence and sexual elements (Coyne, & Whitehead, 2008; İnanlı, 2009). It has been determined in the study that cartoons include violent elements and the native cartoons include less violent elements than the foreign ones. Children learn by imitating, try to apply what they learn, and imitate the cartoon characters they see (Özakar and Koçak, 2012). Uncontrolled television watching and unconscious wrong models may lead to the situation in which the personalities of children are shaped in a wrong manner (Öztürk and Karayağız, 2007).

It has been determined in the study that native and foreign cartoons include goodness, tolerance and solidarity at the highest level. However, bot native and foreign cartoons include less peace elements. Cartoons must carry positive properties in terms of values education (Samur, Demirhan, Soydan, & Önkol, 2014). Especially the ethical behaviors of the cartoon heroes influence children in a positive manner, and have important roles in values education (Güçlü, 2015). This situation might be assessed as an important contribution to the ethical development of children who are at egocentric level. In this way, it might be considered that they may have positive influences both in mental terms and in ethical terms. Making children acquire these values at earlier ages is extremely important (Işitan, 2014). The positive influences of cartoons may help families.

## CONCLUSION

The development at preschool period is very fast, and creates permanent influences in the lives of individuals, and is important in this way. The most important things is guiding children to watch programs that include positive contents or decreasing the negative contents of the existing ones in some way or another (Özdemir Adak, & Ramazan, 2012). According to the results of the study, the positive properties of the native cartoons are higher than those of the foreign ones. When the contribution the cartoons to the development and educational process of children are considered, it is considered that choosing native cartoons will be more suitable.

## Suggestions

- All parts of a selected cartoon may be examined in detail.
- The increase in the number of the native cartoons will help to raise good model individuals who have nationalistic conscience, which is stated in the Basic Principles of the National Education. For this



reason, native cartoons may be preferred in the preschool period.

- The existences of negative elements in cartoons that are imported from foreign countries threaten the healthy development of the children living in Turkey. For this reason, the important cartoons must be examined in detail by specialists who have academic insight and the negative elements must be eliminated before broadcasting.
- Native cartoons also have the duty in transferring the Turkish Language, which is one of the most important elements of the Turkish Culture. The fact that native cartoons will have an important role in teaching Turkish must be considered, and academicians who have duty in the field of Turkish Education must be consulted.

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# ANALYSIS OF GAMIFICATION OF EDUCATION

Emel Koc Avsar  
Okan University, Istanbul, Turkey  
[emel.koc@okan.edu.tr](mailto:emel.koc@okan.edu.tr)

## ABSTRACT

In the last decade, there has been considerable literature on gamification of education. Based on the resulting experience, the educational community indicate consensus on necessity of “gamification” of education to improve the quality of education. The study presented here is motivated by this necessity and aim to review literature related to the use of gamification of education.

“Gamification” is about motivation and engagement. Making learning fun does not require huge investments in technology. Instead, focusing on the ways that entertainment technology engages us can result in methods that we can transfer to any learning situation. Many educators have attempted, with varying degrees of success, to effectively operate game elements to increase student motivation and achievement in the classroom.

There have been many obstacles in their courses as the intellectual challenges of mastering the content of the course. To overcome these obstacles, students are expected to engage in critical thinking and push themselves to consider new ideas. In order to overcome these obstacles, a large collection of proven techniques such as abstraction, decomposition, iteration and recursion which has called computational thinking will be integrated to gamification of education.

**Keywords:** Gamification, gamification of education, computational thinking

## 1. Introduction

Gamification, defined by Deterding at al. as the use of game design elements in non-game contexts [1]. Also, gamification can be defined a process of providing affordances for gameful experiences which support the customers overall value creation [2]. Although gamification has quite a few definitions, they all seem to show gamification to the goal of engagement and motivation.

Motivation and engagement are significant milestones for the completion of a task or confidence of a specific behavior. In today’s digital generation gamification in education has become a popular tactic to encourage specific behaviors and increase motivation and engagement. These are intelligent role because identifying, remembering and understanding were incorporating lower order, progressing to higher order thinking skills in subsequent levels such as analyzing, evaluating, critiquing, summarizing and finally arriving at the highest order thinking skills in the final levels as composing, creating, designing, planning and inventing [3].

There are two types of motivation such as extrinsic and intrinsic. Extrinsic motivation exists when motivation is aroused by forces outside of an individual. Intrinsic motivation is aroused from within an individual. Intrinsic motivation remains an important construct, reflecting the natural human propensity to learn and assimilate. However, extrinsic motivation is argued to vary considerably in its relative autonomy and thus can either reflect external control or true self-regulation.

The aim of this study to analyze the gamification of education and to build a framework related to this topic. Here I review the gamification characteristics, strengths and limitations in general. In addition to this, the underlying objective is to build a framework to understand the students’ point of view to use gamification in education. The next step of this study is to conduct a questionnaire for students and then to prepare a curriculum depend on their interest. At the end of statistical analyses of the data obtained by questionnaires, I will develop the most appropriate gamification tool based on students’ requirements and integrate it to the current education system within the University in Turkey.

The paper is organized as follows. Section 2 has included gamification in education analysis of gamification. Section 3 describes framework for development of an integrated module. Consequently, section 4 concludes the paper and prospects future work.

## 2. Gamification in Education

Computer science/IT educators are more preferred gamification. Utilizing gamification assumes a certain type of environment that supports incorporating and visualizing the selected game mechanisms and dynamics. I believe that the effective classroom adoption of gamification implies both certain technological infrastructure coupled with an appropriate instructional framework. Today's course management systems, however still offer restricted support for gamifying courses. Since the general population of instructors lacks the necessary skills and time for creating, adopting, and/or maintaining an appropriate supportive technological infrastructure, the early application of gamification to learning emerged mainly in CS/IT disciplines. The lack of proper technological support is one of the major obstacles for applying game elements to education. Thus, the development of software tools that can efficiently support gamification in various educational contexts would contribute to a larger-scale adoption as well as to research on the feasibility and efficacy of the gamification of education.

Finding and sharing of new ways of applying gamification learning contexts that are not limited to extrinsic rewards like achievements and badges and that are more meaningful to the students is very important for increasing the application of this emerging technology in education. While the concept of gamification may look simple, the analyzed work demonstrates that gamifying learning effectively is not.

In the literature, there are underlying dynamics and concepts found in game design are shown to be more consistently successful than others when applied to learning environments, these are: freedom to fail, rapid feedback, progression, storytelling [4]. 'Freedom to fail into classroom design is noted to be an effective dynamic in increasing student engagement. This dynamic provide student is using ongoing self-assessment or that the teacher is using ongoing assessment to inform their teaching [5]. Feedback is already a key element in education. If educators can increase feedback mechanisms, learners will have different ideas from different discipline. Progression has defined in the form of levels and missions throughout game design. Hackathorn and Lieberman used Bloom's Taxonomy as a guide in designing the progression of the course. To illustrate this, lower order thinking skills into the first stages (identifying, remembering, understanding), higher order thinking skills in subsequent levels (analyzing, evaluating, critiquing, summarizing) and finally arriving at the highest order thinking skills in the final levels (composing, creating, designing, planning, inventing) [6]. Another aspect of game design that is called storytelling can positively impact learning in the classroom.

## 3. Framework for Development of a Gamification in Education

According to Werbach [7] gamification has put forward an iterative user centric six step: 1. Define objectives, 2. Delineate target behaviors, 3. Describe the players, 4. Devise the activity cycles, 5. Do not forget the fun, 6. Deploy the appropriate tools. The first five steps of this approach show the sociocultural aspect of gamification. And also step 6 is the deployment of technical components. Successful games use balanced combinations of some of these keys or categories.

The uses of educational games as learning tools reinforce not only knowledge but also important skills such as problem solving, collaboration and communication. Using gamification in education, improve learners' engagement and motivation. Helping educators find the balance between achieving their objectives and catering to evolving student needs. Table show that result of the real world connections examples suggested by the experts.

Topic	Example
Logic	Computer software, algorithms and electrical circuits
Relations, functions and operations	Machines, input/output and factory/product relations
Sets	Classification of distinct objects which have common properties
Numbers	Calculations in shopping, bank accounts and grades, word problems of numbers
Polynomials	Architecture and civil engineering
Quadratic equations, inequalities, and functions	Mathematics used in mechanics (vertical motion, speed and velocity)
Permutation, combination and probability	Actuary, statics and estimation
Trigonometry	Architecture, engineering and measuring the length of objects on earth
Complex numbers	Alternating current and electricity
Logarithms	Radioactive decay, bacterial growth, determining age of fossils, seismology and Richter scale
Inductions and series	Generalization of the ideas in real life (behaviors, blood analysis, solving puzzles), population growth of animals and growth of animals (length of a snake)
Matrix, determinant and linear equations	Cryptography and computer systems
Functions	Piecewise functions (prices of a parking lot, grade intervals)
Differentiation	Finding area and volume of irregular shapes on earth

Source: Results of the real world connections examples suggested by the experts [8]

The intent of this study is to define gamification of education. Gamification directly effects engagement and motivation. Gamification also indirectly leads to acquiring more knowledge and skills. In addition to these, gamification encourages students to perform an action; for example, motivating students to practice computer programming will increase their skills and motivating students to memorize consistently can increase their knowledge.

Applying gamification strategies with technology to curriculums may often do a better job of teaching. However, it does not mean it should be a replacement for a comprehensive curriculum or face to face instruction.

#### 4. Conclusion and Future Work

Gamification presents an opportunity to model and guide the enculturation process of computer science undergraduates. It also has the potential to make the matriculation journey more engaging for a broader range of students if done correctly. Understanding the current culture of CS and the readers department is critical to influencing change through gamification. This process, like any process that involves humans, needs to be adaptive and nondeterministic. What it means to be a computer scientist is subjective and the field of computer science is continuously changing. Werbach's iterative design framework offers a good reference point for seeking change through gamification. Meaningful gamification should focus on creating engagement loops that motivate users to perform desired activity and can be done without explicit integration of game components. An in depth understanding of motivation and fun highlights why some approaches to gamification are not as successful as the researchers would have expected. Both internal and external feedback on the game mechanics and dynamics used are essential to ensure that any gamification process is objective and truly holistic in the development of the student [9].

According to Zichermann and Cunningham; gamification is the implementation of game based thinking or game mechanics in order to engage users and solve problems [10]. Gamification in education can be a powerful strategy when implemented properly, as it can enhance an education program and achieve learning objectives by influencing the behavior of students. So that, gamification of the classroom can leads to increased student

engagement and success. The result of the study presented here in suggests gamification mechanics can provide an educational content for open minded students.

This is an ongoing project with increasing interest and involvement of educational experts. Further research will be conducted as proposed and scheduled. The final result of the study is expected to provide important evidence students and teachers. The optimum procedure for development of an integrated curriculum and the impact of deployed framework in quality of education. I suppose that instructors be able to integrate gamification strategies into course design to more effectively engage students.

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# APPLICATIONS OF CRITICAL THINKING RESEARCH: FOREIGN LANGUAGE TEACHING IN AN INTERCULTURAL CONTEXT

Saltanat Meiramova

International Cooperation and Multilingual Education Development Centre  
Saken Seifullin Kazakh Agrotechnical University

Kazakhstan

[meiramovas@gmail.com](mailto:meiramovas@gmail.com)

## ABSTRACT

This paper reports on a methodology of teaching critical thinking skills in English as a foreign language (EFL) classes in an institution of higher education in Kazakhstan. The study findings suggest that the use of critical thinking impacts students' learning in the content area as it makes them aware of critical thinking as a way to approach intercultural exploration. The research results provide practical suggestions on how to guide students to develop and apply critical thinking skills. The critical thinking-based learning of EFL is conceptualized as the development of teaching strategies to help promote critical thinking in regards to students' intercultural awareness. The paper suggests a sample critical thinking lesson plan for engaging in critical thinking when teaching English as a foreign language and examines critical thinking strategies that can be used to foster critical thinking and relevant skills to deal with various problematic issues of conceptualization successfully.

## INTRODUCTION

In recent years, critical thinking has become a 'buzz word' in educational circles (Fisher, 2001), particularly in North America and the UK (Bailin, Case, Coombs, and Daniels, 1999a). It has also received particular attention in educational journals in Kazakhstan. Following the work of Bailin, et.al. (1999a), we consider the conceptualization of critical thinking as the ability to acquire what can widen our background knowledge, operational knowledge of appropriate standards, knowledge of key concepts, and of certain vital habits of mind. By applying these intellectual resources one can do his/her best to create an environment of critical thinking-based learning through redesigning lessons in which the students are involved.

This paper examines critical thinking strategies, which can be used to foster critical thinking and critical thinking skills to deal with various problematic issues of conceptualization related to intercultural proficiencies successfully. Existing conversations on creating an environment of critical thinking-based learning in EFL classes in an intercultural context in Kazakhstan are also addressed in a novel way.

The objective of the present research is three-fold: 1) to review teaching strategies effective in enhancing critical thinking in EFL classes, 2) to discuss why foreign language teachers should avoid the teacher-centered method to language instruction described by Paul (1995) as "the mother robin teaching" (p.1), and 3) to explore some of the arguments that call for "critical thinking lesson plan remodeling" (Paul, Binker, Martin, & Adamson, 1986). To achieve these goals, a review of the research literature on critical thinking provides a background for the study. It considers the concept of critical thinking, the critical approach, the strategies and skills associated with them, and how to teach thinking critically to develop an effective critical thinker. Second, these underlying issues are discussed in connection with the pedagogical teaching implications, and specifically those present in an EFL classroom. They are discussed as specific ways of applying critical thinking to EFL classes by providing the practical instructions on designing or redesigning a critical thinking lesson plan. The summary of theoretical premises and pedagogical suggestions and their implications conclude the discussion.

## THEORETICAL OVERVIEW

Although the term "critical thinking" is used widely in reference to teaching and learning and is often in the center of educational discourse, many educators are unclear of what critical thinking is. Davidson (1998) commented on a survey research completed by in Ruminski and Hanks' in 1995, who found that "the majority of 172 college journalism and mass communication educators had no clear concept of what critical thinking was, though 89 percent of them believed themselves to be teaching it" (p.120). A review of relevant sources reveals differences in the way critical thinking is conceptualized and therefore defined. According to Bailin, Case, Coombs, and Daniels (1999), critical thinking is "a normative enterprise in which, to a greater or lesser degree, we apply appropriate criteria and standards to what we or others say, do, or write" (p.285). In his discussion of critical thinking in TESOL, Atkinson (1997) argued this type of conceptualization with a different and rather controversial point of view when he defined critical thinking as a "social practice" (p. 72) and concluded that "critical thinking is cultural thinking" (p. 89) – heavily dependent on socialization patterns and therefore approached with caution in the teaching of English as a non-native language. In contrast, Davidson (1998) offered multiple researchers' definitions of critical thinking – and some of the suggestions included "the

educational cognate of rationality”, “healthy skepticism”, and “reasonable and reflective thinking that is focused upon deciding what to believe and do” (p.121). Additionally, critical thinking was often defined as “a cognitive activity, associated with using the mind” (Cottrell, 2005); “a basic competency, akin to reading and writing, which needs to be taught” (Fisher, 2001); the ability to recognize, construct, and evaluate arguments, where an argument means “the presentation of a reason(s) to support a conclusion(s), or: *Argument = Reason + Conclusion*” (Haskins, 2006, p.6); and “that mode of thinking – about any subject, content or problem – in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them” (Paul, Fisher, & Nosich, 1993, p.4). This paper adopted a working definition of critical thinking as an *activity where one can build confidence in his/her own ability by applying techniques in argumentation and reasoning to challenge other people’s views from an informed perspective when this is appropriate.*

The described multiple definitions of critical thinking highlight the multidirectional understanding educators apply to the discourse on critical approaches. More specifically, the employment of teaching strategies that promote and enhance critical thinking in EFL classes is justified by the fact that the ability to recognize, construct, and evaluate, which are inherent when engaged in language learning, are at the heart of critical thinking. Yet, these existing connections, raise culture-specific issues that need to be further addressed. In our efforts to seek applications of critical thinking in EFL teaching specifically in Kazakhstan, it is important to address claims of perceived inappropriateness of teaching critical thinking in the Asian context. Presenting the background for such claims, Hongladarom (1998b) stated that “some Western educators who teach at schools or universities in a number of Asian countries have voiced their difficulties and problems they encounter while trying to teach critical thinking and other related skills to Asian students” (p. 1). He further commented on an idea shared by both Davidson (1995) and Atkinson (1997) - that successful utilization of critical thinking skills for some Asian students is influenced by elements in their culture. In response, Hongladarom argued that “critical thinking is not necessarily incompatible with Asian traditional belief systems” (p. 1). On the contrary, he suggested that Asian cultural traditions could be and are reexamined, reinterpreted and adapted in the conditions of the contemporary world (p.2).

This article itself is a glimpse into how language learning and teaching are reflective of history and culture and their influence on the thinking and attitudes of people who belong to different cultures. The authors support Hongladarom's ideas that historical events and social decisions do play a significant role in adopting a particular set of values and his suggestion that societies evolve for the benefit of their members, in relation to the present circumstances of the world while they learn lessons from their historical experiences. As Paul et.al.(1995) stated, knowing world cultures, religions, politics, geography has become so essential that without this understanding survival seems to be impossible in the coming centuries.

### **CRITICAL THINKING IN THE CLASSROOM**

The next concern is how critical thinking teaching fits with language instruction, how and when critical thinking should be introduced to students, and how students’ use of critical thinking skills in classroom activities applies particularly in an intercultural context. Scholars have questioned the relevance of critical thinking to language teaching. For example Fisher (2001) argued that although critical thinking skills are taught “to facilitate their transfer to other subjects and other contexts” (p.1), they are not considered to be taught in an intercultural context. Atkinson (1997) also expressed doubts that critical thinking is “appropriate for ESL/EFL classes” (p.72). Tsui (1999) studied students’ self-reported data on growth in critical thinking in a variety of disciplines, including foreign language courses. Tsui examined the role of the type of course and form of instruction, and found that both need to have association with critical thinking in order for students report growth. However, slightly greater impact was found for instruction.

Tsui (1999) concludes that “the identification of instructional techniques that are influential to critical thinking can assist those within the academic community to implement changes that will enable courses across the curriculum to become more effective in meeting the widely supported educational objective of educating students to think critically” (p.198). However, more research is needed to develop better understanding of the issue in the realm of EFL courses. For instance, Davidson (1998) considered that “the task of the ESL/EFL teacher is to prepare students for the world outside their societies” and what is most important is that “many students are ready for and in need of critical thinking” (p.122). He continued to suggest that EFL teachers further have the responsibility “to prepare learners to interact with native speakers who value explicit comment, intelligent criticism, and intellectual assertion” (p.121). Davidson further stated that “maybe even more than the L1 teacher, we as L2 teachers have good reason to introduce higher level students to aspects of critical thinking” (p.121). Thus, it is up to the language educators to bring and include critical thinking approaches into their own teaching situations to benefit the intercultural context of ESL/EFL classes.



According to Cottrell (2005), critical thinking teaching benefits the development of critical thinking skills in terms of “improved attention and observation, more focused reading, improved ability to identify the key points in a text, to respond to the appropriate points in a message, skills of analysis” (p.1-2). More specifically, critical thinking includes cognitive skills in (1) interpretation, (2) analysis, (3) evaluation, (4) inference, (5) explanation and (6) self-regulation, which are at the core of critical thinking (Facione, 2010, p.5). Particular attention is given to understanding the language of reasoning, developing different kinds of arguments, and asking the right question, as well as how to clarify and interpret ideas, how to judge the credibility of claims, and how to evaluate decisions. As Facione (2010) discriminates between weak and strong critical thinker in the way they in terms of “how they approach specific issues, questions, or problems”. (p.11). As teachers, we have observed moments when our students can express their opinion but they fail to give good reasons - and this is an issue for us, teachers, to recognize and address. To support the need to explicitly teach these approaches, Fisher (2005) shared her own practice of teaching critical thinking skills to students in a university context for some years. After completing the course, one of her students summarized how these skills were very useful in other courses and noted that “These skills are so useful, I cannot understand why we were not taught them at school.” (p.12). Two of the six core cognitive critical thinking skills (Facione, 2010) appear to have greater importance in the foreign language classroom, namely ‘explanation’ and ‘self-regulation’, as good critical thinkers should know how to explain what they think and how they have arrived at that judgment. In addition, students can apply their power of critical thinking to themselves and revise and improve their previous opinions. Many experts evaluate an effective critical thinker as someone who has ‘a critical spirit’ (Siegel, 1988. p.1-2), and is “fair-minded in evaluation,” “honest in facing personal biases,” “prudent in making judgments,” and ‘willing to reconsider’(Facione, 2000. p.65-66). However, the focus on the question of instructional strategies for enhancing critical thinking skills is lacking in the literature (Paul, Fisher, & Nosich,, 1993; Facione, 2010; Bailin et.al., 1999).

Another concern relevant to the implementation of critical thinking strategies in the foreign language classroom is the need for departure from some established teaching practices that are not conducive to the use of critical thinking skills. Paul (1995) described this style as “when we teach in mother robin fashion - trying to mentally chew up everything for our student, so we can put into their intellectual beaks to swallow - students tend to become, if I can slightly mix my metaphor, ‘Polly parrot’ learners” (p.1). Development of critical thinking skills for students is first and foremost a task for teachers to complete – as their instruction must encourage students to think critically and provide conditions for students’ autonomy to do so. In this sense, this research supports Paul’s statement that “both teaching and learning today are desperately in need of restructuring” (p.1). To do so, teachers need to reevaluate and reconsider their ways of teaching, their role in the teaching process, and in the case of foreign language instruction, how to correlate the teaching of the language with the presence and influence of the different, sometimes opposing, cultural realities. Thus, the inclusion of critical thinking activities is a call for a redesign of instruction. Teaching in critical thinking context is the means by which students can acquire knowledge, master content, and solve problems – all key to building advanced language proficiency geared toward production and communication in intercultural context. And if students become skilled in figuring things out – while reading, writing, speaking, and listening, while studying the subjects that they should master in the target language, while tackling the problems of everyday life related to the use of that language – then they will become proficient in ways that make them independent, self-directed learners. It depends on the foreign language teachers, their well-defined learning goals and objectives, and their good thoroughly circumspect lesson plans to achieve it in the classroom.

### CONNECTIONS TO THE CLASSROOM

According to Kizlik (1997), becoming a professional teacher depends on one’s commitment and practice, skills in planning lessons and learning activities, as well as in managing classroom behavior. Although we expect that college level students are at least partially self-regulated learners who come to our classrooms with skills in applying learning strategies that are most conducive to their own learning, the college instructor also need to constantly refer to Kizlik’s description. The importance of in-depth lesson planning and its elements; from clearly defines instructional objectives to classroom management, types of activities, and materials, remains critical for effective foreign language teaching. Moreover, our ways of planning and teaching need to be dynamic and changing along with the ways our students change – an important consideration in a changing higher education landscape worldwide. Kizlik (2009) focused attention on the importance of writing learning goals and objectives for effective teaching and learning. In the light of exploring opportunities for including critical thinking in EFL classrooms, it is important to emphasize that the difference between learning goals and objectives is based on their level of specificity. Goals are broad and generalized statements about what is to be learned, while objectives must be specific to the lesson and observable in students’ behavior. Therefore, both goals and objectives are very important in teaching in order to develop a set of performance expectations, which then enable educators to develop content that is appropriate to their instruction. In addition, well-written

objectives can also be an effective tool for measuring students' learning. Lewis (1977) supported this idea by saying that "effective teaching depends upon (1) how clearly the students understand what they are supposed to learn and (2) how accurately that learning can be measured" (p.1).

One way to blend together the theoretical ideas for inclusion of critical thinking as part of EFL classes with the relevant planning for effective learning is to plan lessons that use Socratic questioning in a form of organized Socratic discussions. The main points of Socratic questioning are that they assist students in creating justifiable meaning using high levels of thought in discussion, provide practice in critical thinking, and encourage them in pursuit of their curiosity about the context of the ideas in question. It can be used to expand student's familiarity with works drawn from various sources, including some from non-Western traditions and from minority groups within any society. It should be noted that other types of questioning, like leading questioning or general questions, don't support the development of critical thinking skills in the way Socratic questioning does, as they don't guide the student in a desired direction of thinking. In contrast, Socratic questioning stimulates students' thinking and helps them to create their own way of thinking and judging. According to Dewey (1910) the degree of reflection influences the degree of learning, and reflection can be stimulated by the questioning strategies promoted in the classroom. Thus, the Socratic questioning can be used to get students to think about a subject and to probe what students already know about it. In addition, we can see if they understand the given problem or idea.

A Socratic seminar lesson in the foreign language classroom could be further enhanced by using 'thinking maps' which help improve thinking by asking key questions to students when they are faced with different types of problems (Fisher, 2001). According to Fisher, "applying a 'thinking map' to your own thinking can be difficult at first so it can be useful to put students in pairs for this purpose - one doing the exercise whilst the other helps them focus on answering the questions in the thinking map" (p.ii).

In the review of the literature, we have reached the point of translating general theory into specific teaching strategies. Below, we present teaching strategies that we have found to be effective in enhancing critical thinking in EFL classes. The level of students' skill in using these strategies was responsibility of the teacher and her/his decision-making and thinking. Through data analysis and discussion, we report which critical thinking skills helped students to think their own way through the ethical insights that underlie becoming a fair-minded thinker. Finally, based on the theoretical overview from the literature, this paper explores five basic understandings of why to design critical thinking lesson plan remodeling (Paul et.al., 1986) and offers some practical pedagogical implications.

## **METHODOLOGY**

In this study, Socratic questioning was used in promoting critical thinking in a foreign language environment. It is illustrated here by examining the teaching of a course titled "Linguaculturology" to Kazakhstani students. Linguaculturology is an elective course for fourth year upper-intermediate level students majoring in Foreign Philology. It is aimed at gaining knowledge about the culture where the target language is spoken in order to be able to interpret and synthesize the cultural phenomena and its influence on language. It is taught during seventh semester in the Foreign/English Philology program at the L.N.Gumilyov Eurasian National University in Kazakhstan. For this study, the students met four times a week for 50 minutes over a period of 15 weeks in 2009.

The average number of the students in the course was 25, and as Kazakhstan is a multinational country, most of students are polylingual, because their native languages are Kazakh, Russian, Tatar, Ukrainian and German. There were no native speakers of English. The course is taught in English as a target language because students study at the Foreign Philology Department to get the specialty of a bachelor of Foreign Philology with the knowledge of the English Language. In addition to studying English as a first foreign language, the students learn simultaneously choose a second foreign language - French or German – throughout the duration of the program.

The goal of Linguaculturology is defined as developing students' speaking and discussing abilities in English using authentic materials from Internet resources and published articles of foreign and home scholars as well as textbook, manuals and research journals. The main resource for this course is the textbook by Claire Kramersch (1998) titled "Language and Culture" according to which students were introduced and discussed the main topics like: The relationship of language and culture, Meaning as sign, Meaning as action, Spoken language, Oral Culture, Print language, Literate Culture, Language and cultural identity, and Current Issues in Linguoculturology.

The course was taught using questioning techniques, and students were guided to construct knowledge and understanding themselves, rather than only discover or received it from the instructor. One sample activity included an analysis on the differences between the values celebrated in cultures. One discussed example was an American Coca-Cola commercial, and the lack or the existence of analogous values in its Russian, Kazakh or German equivalents. A sample set of questions used to guide students' construction and understanding of the notions 'culture' and 'language' while examining values present in the commercials during the activity included:

- What do you mean by...?
- What is your main point?
- How does language relate to culture?

Some questions that probe assumptions like:

- What are you assuming by that?
- What do you think culture shock is assuming?
- Why would someone make that assumption?

And questions that probe reasons and evidence such as:

- What would be an example?
- How do you know?
- Why do you think that is true?
- What are your reasons for saying that?

The specific practice-based strategies were selected from a large number of critical thinking strategies (Paul et.al., 1986) and included: 1) affective strategies: "those which emphasize the affective side of critical thought, promoting autonomy, empathy, and understanding of obstacles to critical thought" (p. 4); 2) cognitive strategies-macro-abilities: "those which generally require extended use of cognitive skills, emphasizing extended exploration of ideas, perspectives, and basic issues" (p.5); 3) cognitive strategies-micro-skills: "those which highlight a specific, usually brief, critical move" (p.5). Additionally, this paper suggests the inclusion of argumentation skills as a critical thinking strategy. To support this division we rely on thoughts of Paul et.al. that "critical thinking requires integration of the affective and cognitive dimensions of thinking, macro-abilities usually require use of micro-skills" (p.4), micro-skills are defined as "pointless unless used to some end" (p. 4). As for argument, it is on the one hand, a tool of giving good reasoning, and on the other hand, highlighting the conclusion. The complete set of strategies is included below.

#### A. Affective Strategies

- developing confidence in reason
- developing intellectual humility and suspending judgment
- exercising fair-mindedness
- developing insight into egocentricity or sociocentricity
- thinking independently

#### B. Cognitive Strategies - Macro-Abilities

- reasoning dialogically: comparing perspectives, interpretations, or theories
- reading critically: clarifying or critiquing texts
- analyzing or evaluating arguments, interpretations, beliefs, or theories
- Clarifying and Analyzing the Meanings of Words or Phrases
- Clarifying issues, conclusions and beliefs
- Developing one's perspective: creating or exploring beliefs, arguments, or theories
- comparing analogous situations: transferring insights to new contexts

#### C. Cognitive Strategies - Micro-Abilities

- noting significant similarities and differences
- examining or evaluating assumptions
- distinguishing relevant from irrelevant facts
- making plausible inferences, predictions, or interpretations
- recognizing contradictions

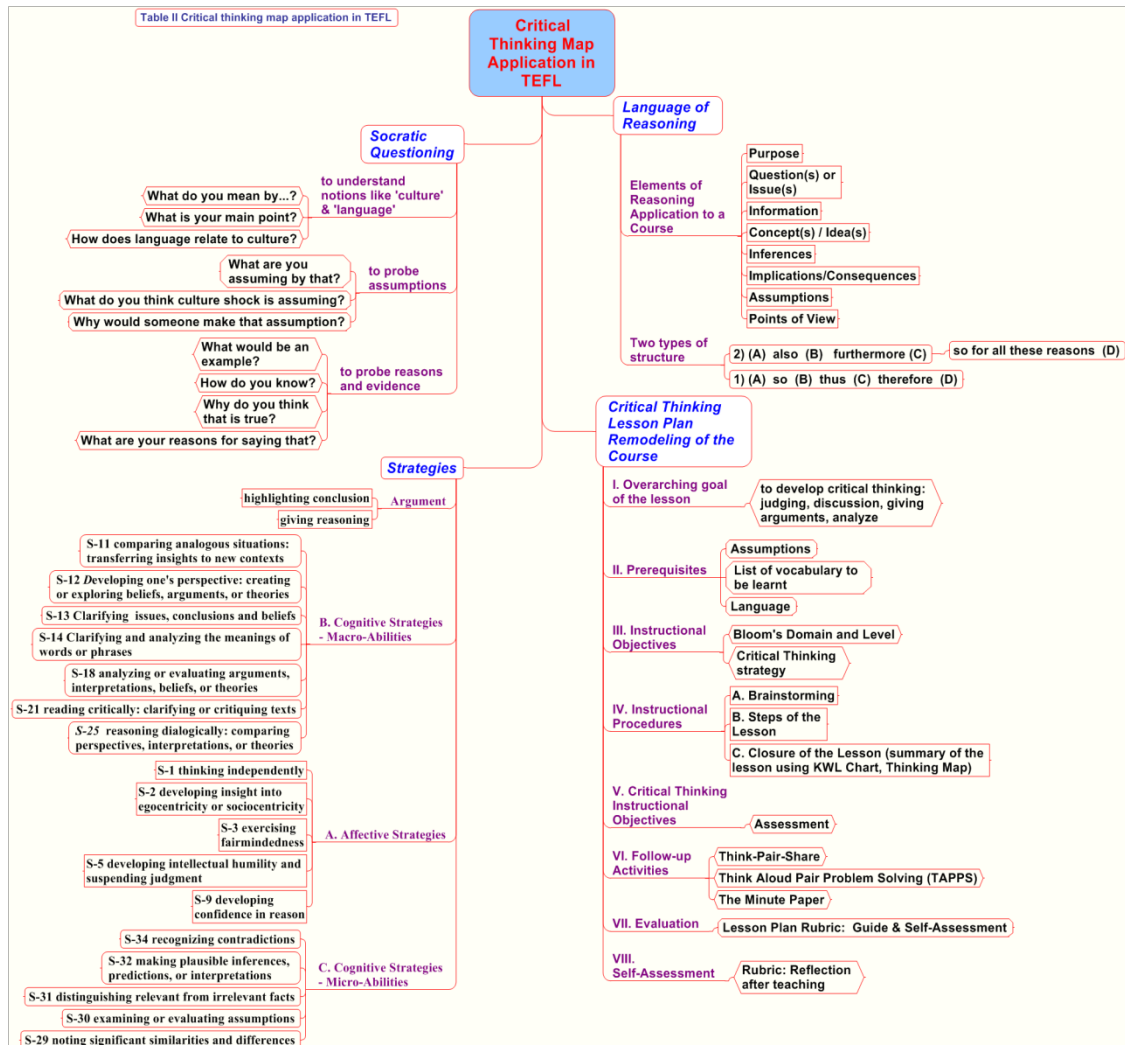
#### Argument

- giving reasoning
- highlighting conclusion

**RESULTS**

Students' experience building and applying critical thinking skills in Linguaculturology was emergent, uncertain, and their use of the strategies was subject to revision; it was concerned with what students already knew, and was created in cooperation rather than being a product solely of the author's or teacher's effort. The summary of the four components of the processes that unfolded is presented on Figure 1.

**Figure 1: Critical Thinking Map: Application in TEFL.**

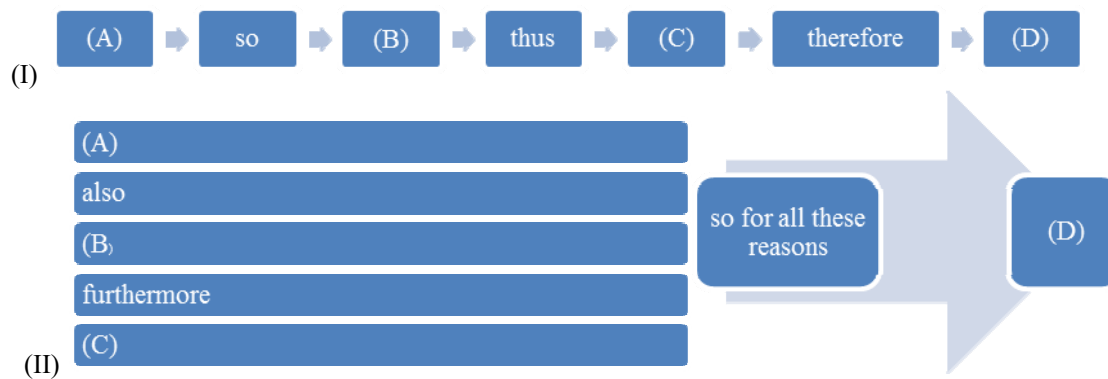


Systematic training of students in insiders' and outsiders' views of cultural phenomena started early on with activities and questioning techniques that required students to adopt different points of view. For example, engagement in the critical thinking process occurred when the class began discussing and defining culture shock as a crucial component of intercultural communication, and then examined its stages. The process highly motivated the students to interact with each other, to take an active part in discussions and, most important, to express their own opinions, show their curiosity about the context of the ideas in question, and think critically. The topics discussed were related to the use of language and included internal cultures (behavior, beliefs, values and thought patterns; the breakdown of communication (verbal and nonverbal greetings, getting down to business, social space, etc); the loss of culturally-specific cues or reinforces (physical and social cues), object loss; and identity crisis. With this specific content and its relevance to the topic, the instructor guided the discussion through appropriate questions and statements and was available to answer clarifying questions. The inferential connection between the five basic understandings of redesigning a lesson plan to include critical thinking and critical thinking strategies was important in fostering critical thinking skills. The approach to critical thinking lesson plan design used here was adapted from Paul, Binker, and Charbonneau (1986). It was based on 1) concept clarification; 2) cognitive interaction of teaching strategies components with critical thinking components; 3) selection of effective ways for strategies components application; 4) assessment of lesson plan remodeling; and 5) a thinking map of argument analysis and evaluation. The thinking map of

argument analysis and evaluation was included because it highlights the relation between the critical thinking efforts, the related arguments, and their premises in order to “identify the obvious and the hidden messages more accurately, and to understand the process by which an argument is constructed” (Cottrell, 2005, p.2).

In order to arrive at a reasonable evaluation of the remodeling of critical thinking lesson plan to include the use of critical thinking strategies, its structure was carefully identified. Due to the fact that critical thinking is a very clear and practical way to reason out problems and to act upon relevant conclusions, the connection between the teaching strategies and the behavior of the ideal critical thinker (Facione 2000, p.65) was fostered in the lesson plan. It was important to recognize the need to apply the elements of reasoning to the course content while designing it, because they were useful when a student tried to: a) persuade to accept his point of view by presenting the reasons, which is called “arguing case” or “presenting an argument” (Fisher, 2001); b) rectify a wrongdoing by giving the reasons in support of the action; c) implicitly assume about something without clearly stating it. Therefore, EFL teachers should carefully consider the language of reasoning including “conclusion indicators”, “reason indicators”, and “argument indicators” because they “give you a vital clue about the structure of the reasoning” (Fisher, 2001, pp.22-23).

Fisher (2001) determined two types of the structure of reasoning: (I) representing “the ‘chain’ of reasoning, where successive conclusions are also reasons for the next conclusion”; and (II) representing different structures (pp.30-31). The first type of structure implied giving a sequence or chain of reasons for a conclusion, while the second implied providing side by side support to the conclusion. By using the language of reasoning, the students enhanced their recognition of the value of an argument and its potential for persuasion purposes. It is convenient to represent these structures in the following way:



Thus, by using the language of reasoning, the EFL students enhanced their ways of recognizing whether an argument was strong and whether was able to persuade them or not. Drawing on the above evidence and on the teaching experience, the implementation of the elements of reasoning in an EFL course is offered together with the practical implications for critical thinking development in the lesson plan. An example is presented in Table I and Instructions 1.1 below.

**Table I:** Applying the elements of reasoning to a course “Context and Culture in Language Teaching”.

Element	Question(s)	Response
Purpose	How is this course intended to benefit students?	To equip students with the tools which will enable them to gain greater awareness of their own cultural values and of intercultural issues, to develop a “working knowledge” of the “target culture” and to develop an understanding of the process of communicating across cultural boundaries.
Question (s) or Issues	What problems and issues will students learn to solve during this course?	Through this course, the students will learn how to solve the problems of the need for intercultural learning and communication that arise from the basic fact that cultures are different, and these different cultures come into contact and communicate with each other. In addition, students will learn how to connect people from various cultural backgrounds and to increase tolerance for diversity and ambiguity.
Information	What kind of information do students need to access during the course?	Students need to access information from a variety of sources, such as textbooks, articles, journals, and Internet. Moreover, we should familiarise students with sources of information about the target culture. Again, newspapers and websites can be an invaluable source of reading materials here. Films and literary texts often depict and interrogate their own cultures.

Concepts/ Ideas	What basic concepts or essential ideas do students learn in this course?	The basic concept, which students will learn is the concept of intercultural competence that should be studied in the <i>context of culture</i> and in the <i>context of specific situations</i> , both linguistic and extralinguistic.
Inferences	What inferences are cultivated during this course? What will students learn to make reasoned judgments about?	While learning in this course, students will acquire an ability to evaluate, critically using the language of reasoning and on the basis of explicit criteria, perspectives, practices and products in one's own and other cultures and countries. Moreover, teachers try not to change students' values but make them explicit and conscious in any evaluative response to others.
Implications/ Consequences	What are the possible implications and consequences of those inferences?	Students will be able to study culture from the perspective of action and communication theories that will increase international and cross-cultural tolerance and understanding. Because culture guides the student's action through the interactive process and offers him orientation in the shape of background expectations and cognitive models. Here, we should emphasize that intercultural awareness in language learning is often talked about as though it were a 'fifth skill' - the ability to be aware of cultural relativity following reading, writing, listening and speaking.
Assumptions	What assumptions are made about the students taking this course	It is suggested that students develop their communicative competence which implies linguistic and pragmatic competences. According to Ellis (1994) by linguistic competence, we understand the knowledge of the items and rules that comprise the formal systems of a language and by pragmatic competence it is considered the knowledge that speaker-hearers use in order to engage in communication, including how speech acts are successfully performed.
Points of View	What points of view will students develop during this course?	Some possible points of view that students may develop during this course are that students enhance their proficiency in nonverbal communication, and their ability not only to interpret native speaker nonverbal communication, but also to adapt their nonverbal communication in ways that enhance intercultural communication and avoid miscommunication, including knowing when and where to perform these behaviours and to whom. Students will learn cultural models of another community by expressing their learned cultural knowledge, linguistic patterns, and discourse patterns, cultural assumptions of that community and by correlating all these patterns with their own cultural tools. Students will also develop a number of points of view via exposure to a variety of topics and perspectives presented in course materials.

Creating a critical thinking-based learning environment in an intercultural context in EFL classes fosters students' abilities to think critically (i.e. critical thinking values like truth, open-mindedness, empathy, autonomy, rationality and self-criticism) when articulating good arguments using the language of reasoning. The role of the teacher in this context is to encourage and to reward students, which may help learners come to believe in their power of thinking and ability to identify and solve problems and decision-making. Another important teacher's role is to ask questions, and keep discussions from becoming confusing by leading students to make fruitful comparisons and contrasts. As an exercise that fosters learner participation, inclusion of role-playing as part of instruction becomes crucial of enhancing critical reciprocity in class activity. In addition, building Socratic questioning into the lesson is another form of probing beneath the surface of things, which is aimed at pursuing problematic areas of thought.

## **INSTRUCTIONS 1.1 CONTEXT AND CULTURE IN LANGUAGE TEACHING**

### **I. Personal constructs**

Step 1: I ask my students to contrast and compare their own culture with other phenomena. For example, the concept of friendliness was constructed by one native speaker of American English (student 1) by contrasting 'friendly' with 'don't like you', then contrasting 'don't like you' with 'trust you', 'trust you' with 'exclude you', 'exclude you' with 'sociable', 'sociable' with 'conceited', and so on.

Another native speaker of English (student 2) might have constructed the concept along a quite different axis of thinking.

Step 2: Then I ask my students in the same manner construct such concepts as ‘challenging’, ‘successful’, ‘happy’, ‘work’.

Step 3: I ask them to choose the contrast that makes the most sense to them, after that they should repeat the procedure four or five times.

Step 4: the task is to compare student 1 line of constructs with that of another speaker of English (student 2).

Step 5: the whole class should analyze how each one may have a socially or culturally different way of classifying the world. Give good arguments in supporting your ideas by using the language of reasoning.

## II. Role-play

Student Tasks:

a) Describe your school and your daily routine to a French student in a lycée. What points will you emphasize, knowing what you know about the French school system and your public or private school? Give good arguments in supporting your points by using the language of reasoning.

b) You are an American salesperson in Germany. Knowing what you know about the way many young Germans feel about nature and ecology, compose a sales pitch for fruit, natural produce, or a beauty product for German ‘green’ buyers.

c) You have been offered a position as a teacher of French in the United States. You have one semester to teach the whole of French history. Which events will you stress to help your students understand better present-day French? How will you interpret these events for them? Give good arguments in supporting your ideas by using the language of reasoning.

The strategies defined above can be applied in more than one way. The teacher should begin to develop the micro-skills first (i.e. noting significant similarities and differences, distinguishing relevant from irrelevant facts, recognizing contradictions) in order to train students “to gain insight into the traits, values, and dispositions essential for strong sense critical thinking” (Paul, et.al., 1986. pp.25-26).

In Table II below, the model of critical thinking lesson plan remodeling is offered.

**Table II:** Critical Thinking Lesson Plan Remodeling of the course “Linguoculturology”.

Instructor: Saltanat	Title of Course: Linguoculturology	Student Age/Level: 4 <sup>th</sup> year students
Title of Lesson: Language and culture: their relationships	Number of Students: 25	Time Allowed: 50 min.
I Overarching goal of the lesson: to develop critical thinking: judging, discussion, giving arguments, analyze		
II Prerequisites. These are assumptions you are making about your students’ skills, knowledge, and experience for this lesson. At the beginning of this lesson, students are expected to have or to know: general knowledge about culture, language, appropriate vocabulary, some skills to debate and play the role play List of vocabulary to be learned: acculturation, act of identity, appropriateness, appropriation, arbitrariness, barbarism, code, code-switching, cohesion, connotation, context of culture, context of situation, context-dependent, cultural identity, cultural literacy, denotation, diffusion, discourse, discourse community, <i>ad absurdum</i> etc. Language – Really? That’s interesting, I didn’t know that! I think that’s a good idea! Are you? Did you? Absolutely, because..., Right! I agree because..., I see what you mean, but don’t you think..., I’m afraid I don’t understand you. Can you... Rubbish! No way! That’s not true! Can you put it another way? etc.		
III Instructional Objectives:	Bloom’s domain and level	CT Strategy (No more than 2 macro-abilities.)
1. (Audience) The students in this course (Behavior) will be able to give a definition of culture and language, define their relationships (Condition) focusing on previously introduced key vocabulary and read different definitions given by outstanding scholars and using paraphrasing techniques (Degree) without plagiarizing.	Cognitive Analysis Level Knowledge level Evaluation level	S-13 Clarifying issues, conclusions and beliefs; S-30 examining or evaluating the assumptions

2. The students will be able to <i>describe the context of culture</i> after reading the article using the background. <i>They should illustrate not less than two- three specifics.</i>	Cognitive Comprehension Level	S-14 Clarifying and analyzing the meanings of words or phrases
3. The students will be able to <i>analyze the context of situation</i> , after answering the comprehension questions focusing on critiquing the article using <i>appropriate vocabulary</i> .	Cognitive Analysis Level	S-12 Developing one's perspective: creating or exploring beliefs, arguments, or theories S-21 reading critically: clarifying or critiquing texts
4. The students will be able to <i>compare and contrast</i> different scholars' point of view focusing on the theme and own attitude to this or that issue.	Cognitive Analysis Level Evaluation Level	S-25 reasoning dialogically: comparing perspectives, interpretations, or theories S-18 analyzing or evaluating arguments, interpretations, beliefs, or theories S-11 comparing analogous situations: transferring insights to new contexts

IV Instructional Procedures:

A. I will open the lesson by: brainstorming the students some definitions about culture and language and then asking them how they consider the statement 'We speak the same language We speak the same culture' and share their ideas in Think-pair-Share groups

B. Steps of the lesson (including instructional techniques, activities. Please also indicate in parentheses where in this lesson the critical thinking strategy(ies) occur):

1) Now the definition of culture and language as a notion is clarified and defined (cognitive strategies-macro skills).

2) With the definition in one's mind, examples are presented. Then we discussed the issues of linguistic relativity which denotes that different people speak differently because they think differently, and that they think differently because their language offers them different ways of expressing the world around them. Then students are asked to think independently (affective strategy) of how to explain Whorf's views on the independence of language and thought which is known under the name of Sapir-Whorf hypothesis. Students will give me reasons of their arguments why they think so, express their attitude to these questions (cognitive strategy-macro skills). Just some students have difficulties to do so.

3) Defining the interpretation of word stereotype, (cognitive strategy-micro skills), students can be asked to discuss in pairs their understanding. After that, the classification of meaning is brought out like conceptual meaning, then they are asked to scan the text "National stereotypes" discuss it, do the assignments after the text.

4) Then each group does the role-play in front of the class (cognitive strategy-macro skill).

5) At last students asked to present their home task 'Countries Project' according to Required Information List

- Country Name
- Description of Geographical Location
- Geographical Features
  - o Explain how the geographical features affect the culture of the target country, i.e. clothing, agricultural products, transportation, etc.
- Role of Education
  - o Importance?
  - o What type of system?
- Importance of Religion
- Role of the Family
- Foods
  - o What foods are important and WHY?
- Traditions



- The Arts
  - o Literature
  - o Theatre
  - o Dance
  - o Visual Arts
- Legends/Myths
- Views on Americans

C. I will bring closure to the lesson by: Summary of today’s lesson using KWL Chart, Thinking Map.

V Critical Thinking Instructional Objectives.

By the end of the lesson,

1. (Audience) The students in this course (Behavior) will be able to give a definition of culture and language, define their relationships (Condition) focusing on previously introduced key vocabulary and read different definitions given by outstanding scholars and using paraphrasing techniques (Degree) without plagiarizing.

2. The students will be able to *describe the context of culture* after reading the article using the background. *They should illustrate not less than two- three specifics.*

3. The students will be able to *analyze the context of situation*, after answering the comprehension questions focusing on critiquing the article using *appropriate vocabulary*.

4. The students will be able to *compare and contrast* different scholars’ point of view focusing on the theme and own attitude to this or that issue.

Assessment

Describe how you will determine the extent to which students have attained the critical thinking instructional objective(s) on the left.

1. Students will work in TAPPS after reading the article “The relationship of language and culture”, then give the definition of culture and language, define the relationships between them using the principle of Sapir about the linguistic relativity. The quality of the analysis will be assessed based on distinguishing main statements on linguistic relativity, clarifying issues, conclusions and beliefs in the form of discussion such as ‘ language and thought reinforce each other’; ‘ language not only reflects, but also shapes reality’; ‘grammar is not universal, it is particular to each language’. Also, the assessment will be based on using appropriate vocabulary list given previously.

2. Students will share their ideas of how they understand the meaning and context of the term ‘the context of culture’, then debate Sapir’s claim that our language determines the way we think. The assessment will be based on eliciting the potential differences between Sapir’s and Whorf’s views on linguistic relativity, describing the most controversial of Whorf’s statements on linguistic relativity and then giving reasonable justifications.

3. Students will give their arguments of understanding the notion of ‘context of situation’, then answer some comprehension questions focusing a concrete example how a grammatical feature in one language formulates an idea which cannot be easily expressed through the grammar of another language. The assessment will be based on the effective use of the appropriate language of the lesson.

4. Students will present/discuss their/others points of views on the analysis of the issues raised by the writer in the article “The relationship of language and culture”. The assessment will be based on the effective use of the language of the article as a sign of their formed skills of argumentation, on the quality of interpretations, as well as their reasonable judgments.

VI Follow-up Activities: What follow-up activities will you use to extend and reinforce the critical thinking components of this lesson (e.g. *Think-pair-Share, Think Aloud Pair Problem Solving (TAPPS), the Minute Paper, homework, follow-up reports for workshops*)? Which critical thinking strategies will these activities target?

*I will ask the students to do the following:*

- 
1. in small groups to discuss the first two paragraphs of the article “The relationship of language and culture” where Pinker seems to claim that people are guided by their senses more than by the language that surround them. They should express their agreement (*S-12 Developing one's perspective: creating or exploring beliefs, arguments, or theories; S-34 recognizing contradictions*).
  2. As homework, write their respond to each of the two arguments to the situation where Pinker pushed Whorf's claims ad absurdum (*S-12 Developing one's perspective: creating or exploring beliefs, arguments, or theories*).
  3. Give further ‘subjective experiences and objective facts’ that might contest the validity of linguistic relativity (*S-5 developing intellectual humility and suspending judgment*).
- 

#### VII Evaluation:

The information I will need in order to appraise the strengths and weaknesses of this lesson are:

1. The number of the students participating.
2. Comments from the students.
3. Lesson Plan Rubric: Guide and Self-Assessment.

I will gather this information by:

- a) assessing their learning outcome through their answers in their homework;
  - b) assessing their speaking performance through the “debate” technique since this can make me know how they master the skills of thinking precisely about thinking by using critical vocabulary and the ability of distinguishing relevant from irrelevant facts.
- 

#### VIII Self-Assessment (your own assessment of your teaching):

My process/technique for reflecting on my own teaching of this lesson will be Proposal Elements: Bridging the Gap-Assessment or Rubric: Reflection after teaching.

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### CONCLUSION

The explicit inclusion of critical thinking in a EFL course guided students to make appropriate use of critical thinking skills and strategies in order to increase its fruitfulness. Our conception highlights the fact that the process of remodeling lesson plan was embedded in complex practices of critical deliberation conceptualizing critical thinking and discussion. Doing so, the critical thinker was guided to acquire good judgment in determining what critical thinking strategies were required in particular contexts.

Our practice and experience in remodeling a lesson plan and implementing it into the EFL teaching process in Kazakhstan can be helpful for teachers as it distinguishes the main components of the process. It also involves practices that are familiar to teachers – like using the Socratic questioning – but further extends the critical thinking nature of the processes by engaging students in tasks that call for reasoned judgment or assessment. This is achieved by providing an environment of critically thinking-based learning in which students are encouraged and supported in their attempts to think critically and engage critically in discussion.

More research on opportunities for engaging EFL students in creating the environment of critical thinking-based learning in EFL classes in an intercultural context will help further explore the processes that arise in critical thinking teaching in EFL classes. The critical thinking lesson plan remodeling **presented here is one starting point** in illustrating the ways for developing students’ critical thinking skills and evaluating them as effective participants in the critical thinking EFL discourse.

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## CORRELATED-FEATURES SEQUENCE AND COGNITIVE STRATEGY EDUCATION BASED ON DIRECT INSTRUCTION MODEL IN MATH SKILLS OF STUDENTS WITH SPECIAL NEEDS

Ulviye ŞENER AKIN

Banu ALTUNAY ARSLANTEKİN

<sup>1</sup> Special Education Department, Gazi University (Ph.D. Cand.), Ankara, Türkiye

<sup>2</sup> Special Education Department, Gazi University, Ankara, Türkiye

For correspondence: [ulviye\\_2000@yahoo.com](mailto:ulviye_2000@yahoo.com)

### ABSTRACT

Math skills are one of the most important skills in daily and academic life for the individuals with special needs. As math skills have a hierarchical structure, students often encounter problems in math skills. Math education needs to be effectively designed for students with special needs. A well-designed curriculum constitutes the basis of the success. The Direct Instruction model differs from other models as it focuses on the generalization with long-term practices and the design of the curriculum. In Direct Instruction model, instruction needs to be analyzed in terms of content and the teacher needs to determine which association types the subjects are divided into within the content analysis. From the simple to the complex, association types are categorized as verbal associations (simple facts, verbal chains and discriminations), concepts, correlated-features sequence and cognitive strategies. The main purpose of the current study is to examine correlated-features sequence and cognitive strategy education based on the Direct Instruction model in math skills of students with special needs.

**Keywords:** Students with Special Needs, Math Skills, Correlated-Features Sequence Instruction, Cognitive Strategies Instruction, Direct Instruction Model.

Math, which has become an inseparable part of daily life activities, is becoming more and more important in the world (National Council of Teachers of Mathematics, 2000). Math has a significant place in everyone's life and math education is one of the most leading academic subjects which is considered critical for all individuals in both developed and developing societies. In classrooms, adaptations and arrangements are required in teaching mathematics not only for the students with special needs but for all students. It is pointed out in the studies that effective math education constitutes the basis of success of individuals in business and real life in the future (Bryant, Bryant, Kethley, Kim, Pool & Seo, 2008). Especially, individuals with special needs are required to have adequate acquisitions in math-related processes in order to adapt to the social life. As new concepts, terms, symbols and skills are being learned, previous skills need to be remembered and applied, as well. The report of the National Mathematics Advisory Panel (2008) states the need for math curriculum that encourages student success and use the researched-based instructional strategies in maths. Achieving a level of mastery with basic math concepts for student is quite critical. Also special need of the student can further compromise student learning (Spear-Swerling, 2005). For instance, the studies show that students with learning disability have problems in recalling (Kavale & Forness, 1992; Scruggs & Mastropieri, 1986; Cooney, & Swanson, 1986) and that children with emotional & behavioral disorder often have troubles with attention, memory and high-level thinking skills (Shaywitz, Escobar, Shaywitz, Fletcher, & Makuch, 1992). Individuals with special needs may have more difficulty in acquiring concepts, recalling the mathematical processes and rules as well as making them functional, and in analyzing mathematical problems (Butler, Miller, Lee & Pierce, 2001). Additionally, it was reported that students with special needs tended to drop out twice more than normally-developing students (Blackorby & Wagner, 1996). As math displays a high-level hierarchy (pre-requisite skills), the problems especially in the basic skills (for example, counting with fingers/not having fluency in basic addition) make the processes more complicated (addition with carrying, etc.). Acquisition of a math skill greatly depends on the previous math skills. Therefore, math education needs to be designed in the best way that students can learn effectively. Instructional procedures, which are effective in functional math subjects, in accordance with the performances of the individuals with special needs are very important in understanding and applying academic subjects.

In effective instruction practices, one of the most important factors that affect the success of the student is the quality of the teacher (Billingsley & McLeskey, 2004). Therefore, it is very important for special education teachers to have the necessary educational background and experience to teach math skills to the students. Including effective teaching principles to help students acquire and generalize math concepts and skills are directly related to the quality of the education (Scarlato & Burr, 2002). Other factors that affect the success of the students are curriculum and instructional materials. In a review of research literature, (Kame'enui, Carnine, Dixon, Simmons ve Coyne, 2002; Lenz & Deshler, 2004), it is recommended to develop the curriculum and instructional materials with the purpose of helping the individuals with special needs learn and acquire skills. It is necessary to pay attention to develop a systematic strategy instruction in educational environments for the

individuals with special needs or for the individuals at risk. A graduated instructional sequence into instruction aims to help students advance to abstract levels of math understanding using the concrete-semiconcrete-abstract sequence (Maccini & Ruhl, 2000). In this context, National Council of Teachers of Mathematics (NCTM, 1980) have eight recommendations to offer math education in a dynamic and forward-thinking approach in accordance with the necessities of the time. Five of these recommendations cover the students with special needs. These are; 1) It should focus on math problem-solving studies at school, 2) It should focus on the basic skills in math rather than calculating skills, 3) Math curriculum should evaluate the student performance and success rather than traditional tests, 4) Computer technology or calculator which may help in math classes should be provided, 5) Math studies should be supported with various intense activities within a flexible curriculum. Also a schema-based instruction to encourage students represent the underlying math structures to solve the problems (Xin, Jitendra & Deatline-Buchman, 2005). Hence, it facilitates contextualized problem-solving skills and generalization to contextualized problem types (Bottge, 1999). Worries with the low math performance of U.S. students followed to more logical standards for teaching and learning mathematics, as well as greater student accountability. The National Council of Teachers of Mathematics (NCTM, 1989, 2000) developed standards for teaching math that mirror a greater focus on awareness with concepts (i.e., emphasizing meaning rather than meaningful memorization), mathematical reasoning, and problem-solving skills that can be easily adapted into real-life situations.

The way to put these recommendations into practice may be to professionally develop the teachers and to enable them to use effective materials, and to encourage the teachers to use research-based practices (Sener & Belfiore, 2005). Walberg (1990) summarized the results of approximately 8000 studies. Based on the summary, one of the two common traits of the instruction methods supported with experimental evidences is overachievement expectation, and the other is incentives (Özyürek & Tuncer, 2003). One of the practices supported with experimental evidences is the Direct Instruction model. The most comprehensive research that tested the efficiency of the Direct Instruction model is Follow Through Project. Follow Through Project is the biggest educational research in history. The research was conducted with approximately 100.000 students in 170 residential areas. The Model was experimentally proved to be efficient with other studies conducted after the project as well.

According to the Direct Instruction model, word problem solving instruction was proved to be efficient in the studies with different groups with special need. It was observed that the practices conducted by Bayram, 2006, Tuncer, 2009 and Karakoç (2002) according to the Direct Instruction model increased the word problem solving performances of visually-impaired students. Furthermore, researchers examining cognitive strategies especially focus on teaching of multiplication (Irish, 2002), the teaching of test-solving steps (Kretlow, Lo, White, & Jordan, 2008) and addition & subtraction in fractions (Test & Ellis, 2005) in mathematics. There are extensive studies on other academic subjects such as physical sciences (King-Sears, Mercer, & Sindelar, 1992) and social sciences (Brigham, Scruggs, & Mastropieri, 1995). Yet, it is remarkable that uncorroborated traditional methods (e.g. modality instruction) rather than proven practices are often used at schools (Ysseldyke & Burns, 2009). The main purpose of the current study is to examine correlated-features sequence and cognitive strategy education based on Direct Instruction model in math skills of students with special needs and then to discuss the reflections of the studies in the literature.

### **Direct Instruction Model**

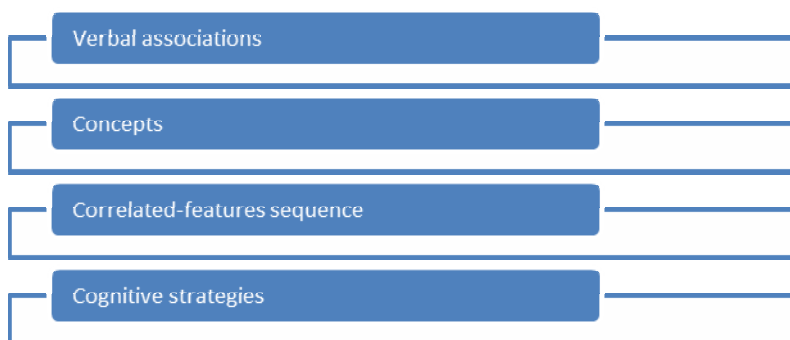
Direct Instruction Model was developed for the teaching of cognitive skills. The Model is described as a teacher-centered instruction model which focuses on curriculum design for the success of the student and which includes generalizable teaching strategies as well as written teaching processes (Engelmann & Carnine, 1991; Tuncer & Altunay, 2004). Direct Instruction Model, theoretically based on the studies of Engelmann and Carnine (1981), emphasizes that the changes on students can be assessed and evaluated when a planned instruction is systematically offered to the students. In the model, the most significant characteristic of the instruction skills is that they do not vary from practice to practice and according to the personal styles of teachers. In Direct Instruction model, the role of the teacher in the learning process is well-defined and instruction skills are practically explained. It is suggested in this approach that every child can learn when the factors of the teaching process offered to the student are well-controlled. In instructive approaches like Direct Instruction model, the importance of the factors such as supporting the curriculum in learning-teaching activities, selecting the examples to be presented for the teaching process, observing the improvement of the student, and systematically correcting the mistakes of the student is pointed out (Tuncer & Altunay, 2004).

The fact that the Direct Instruction model designs the instruction materials as well as the teaching process contributes to the students' reaching their objective in a short time. While designing the curriculum in Direct Instruction model, firstly, the content analysis should be conducted; in other words, it should be reviewed in terms of association types and "Big ideas" (Kameenui & Simmons, 1990; Kozloff, Lanunziata, Cowardin & Bessellieu, 2000/2001; Tuncer & Altunay, 2004). The second important factor is open communication. Open communication is to organize a presentation in order that a student can make a maximum

number of generalization out of the examples. The examples to be presented are carefully selected and arranged in an order so that the student can see the related and unrelated qualities of the concept. The third factor is the format of the instruction. Based on the association type with planned instruction, the teacher's way of presenting the examples, the questions to be asked to the students, and how to make a correction in incorrect responses are specified (Watkins & Slocum, 2003). The fourth factor is the ordering of skills. It is the teaching of easier skills before the harder ones (Carnine, Silbert, Kameenui & Tarver, 2004). Lastly, Direct Instruction Model has an organization which can be called as strand curricula (Przychodzin, Marchand-Martella, Martella & Azim, 2004). Thanks to the strand curricula, students have the chance to utilize various concepts and skills in wider concepts and to perform distinguishing practices (Watkins & Slocum, 2003). Carnine (1980) lists the help reduction, which is required in any well-designed curriculum, as follows: (1) from proceeding with open problem-solving strategies towards more closed problem-solving strategies, (2) from a simpler presentation towards a more complex context, (3) from performing a skill by taking clues towards performing it without a clue, (4) from massed exercises towards distributed exercises, (5) from instant feedback towards delayed feedback, (6) from the teacher as the information source to the student as the information source. There are four basic elements of the arrangement of teaching process in Direct Instruction Model. These are to group the students based on their educational needs, to utilize the instructional time, written teaching processes and to continuously evaluate the performance of the student.

#### *Association Types in Direct Instruction Model*

The fact that the teacher can discriminate the association types is very useful in instruction presentation and practice phases. Being aware of the type of association is very critical in terms of how to organize the class, how to select the examples, and what changes can be practiced on the teaching process.



#### *Verbal Associations and Concepts*

Verbal Associations are defined as the combination of a special stimulus and a special response type which constitutes the basis of high-level information (Kameenui & Simmons, 1990; Tuncer & Altunay, 2004). Verbal associations are categorized as simple facts, verbal chains, and discriminations. Basic addition ( $3+2=5$ ) (simple facts), line counting, rhythmic counting (verbal chains) and numerical reading (discriminations) can be given as an example to verbal associations. Instruction phases are modeling, guided practice and independent practice. In modeling phase, the teacher instructs verbally or visually. In guided practice phase, the teacher and the student repeat the information together until it is ensured that students can express the information (Kameenui & Simmons, 1990; Marchand-Martella, Slocum, & Martella, 2004). Independent practice is the phase where the students express the information independently (Kameenui & Simmons, 1990). Modeling and guided practice phases are the critical phases to enable the student to perform the independent practice.

Concepts differ from verbal associations in terms of content variation as well as example connection in order to use them (Kameenui & Simmons, 1990). There are narrow and wide range of examples, example selection and sequence in concepts; however, in verbal associations, discriminating the other examples or recalling an example or examples arranged in order are required. A teacher who knows how to classify the concepts can specify the instructional requirements of concepts (example selection, sequence, presentation of teacher, etc.). The instruction of the concepts within the same concept variation shows similarity (Kameenui & Simmons, 1990). For instance, the example sequence is the same in the instruction of "tilted" concept and "under" concept within the same concept variation; however, the example sequence differs in different concept groups. For example, the way followed in example selection and sequence to teach "more and less" concepts should be different from the way followed to teach "triangular prism, cube and sphere" concepts.

### *Correlated-Features Sequence*

Kameenui and Simmons (1990) describe the correlated-features sequence as the proposition that determines the special relationship between at least two facts, discriminations or concepts. It is suggested that correlated-features sequence instruction can be utilized in order to present the connection between a stimulus and another event that occurs simultaneously, but cannot be observed (Tuncer&Altunay, 2004). "If the bottom number is higher than the top number, we break the decimal", "when we multiply a decimal with ten, we shift the comma to the right for one digit", "even if the place of the numbers changes, the result does not change in an addition process" can be given as an example to the correlated-features sequence.

The propositions regarding the correlated-features sequence also show which examples will be presented and how these examples will be figured for the presentation (Kameenui& Simmons, 1990). Two questions are asked in the presentation of examples in correlated-features sequence. The first question enables to follow a routine by applying the rule specified in the proposition, and the second question enables to make a connection between the result and the proposition. For example, the teacher asks, "should we break a decimal?", and the student answers, "Yes". The teacher asks, "How do you know?", and the student answers, "the bottom number is higher than the top number".

Correlated-features sequence instruction differs as one-dimension inclusion and multiple-dimension inclusion. One-dimensional correlated-features sequence involves the relationship of an event or concept with another event or concept. If this relationship is one-dimensional, there are some principles to follow in order to organize a correlated-features sequence presentation. The correlated-features sequence to be taught in order to determine how to select the examples and how to arrange them in order is stated as a proposition. In order to determine if the proposition is a concept or if it contains another type of association, the proposition is resolved and the presentation sequence of the examples is determined based on this. As there are nouns in the proposition in some correlated-features sequences, the examples are sequenced as in the noun presentation. For example, the "on" concept is mentioned in the correlated-features sequence as "it is a full hour if the minute hand is on 12". As the "on" concept is a non-comparative sequences concept, the presentation is performed according to the example sequence of the non-comparative sequence concept. The teacher gives 3 positive "full hour" examples (01:00, 04:00, 08:00), and 2 negative examples considering that the first negative example is the least different example (08:10), and then asks the evaluation questions. An example of one-dimensional correlated-features sequence instruction is given in Table 1.

Some correlated-features sequences contain multiple dimensions. In such correlated-features sequences where two features are together, the presentation starts with the positive example. Some correlated-features sequences carry one or another of a few dimensions. In such correlated-features sequences, the presentation starts with the negative example. If the presentation starts with the negative example, the assessment is clearly seen (Engelmann & Carnine, 1991). Most of the rules in math field constitute the basis of high-level cognitive strategies. For example, the fact that a student learns when to use the carrying method makes it easier to make "addition with carrying" by using the rule of carrying method later. Therefore, it is very important for the student to learn these rules and to use them fluently in order to utilize them within cognitive strategies.

Table Example 1 and 2 show two sequences that derive from the fact; If you make the top and bottom of the fraction the same, you make a fraction the same, you make a fraction that equals one whole. The first sequence treats the relationship as a single-dimension discrimination and places a choice-response test. The second sequence treats the relationship as a transformation and requires the learner to different transformation responses. The sequence starts with a negative and three positives, The learner needs to categorize each example (Engelmann, S. & Carnine, D., 1991).

*TableExample 1.*

*A Choice-Response Sequence*

Example	Wording
1. 5/4	My turn. Does this fraction equal one? No. How do you know? Because the top and bottom are not the same.
2. 4/4	My turn, again. Does this fraction equal one? Yes. How do you know? Because the top and bottom are the same.
3. 98/98	Your turn. Does this fraction equal one? How do you know?
4. 7R/7R	Does this fraction equal one? How do you know?
5. 7/7R	Does this fraction equal one? How do you know?
6. 14/8	Does this fraction equal one? How do you know?
7. 12/12	Does this fraction equal one? How do you know?
8. 81/5	Does this fraction equal one? How do you know?
9. 241P/241P	Does this fraction equal one? How do you know?

*TableExample 2.*

*A Transformation Sequence*

Example	Wording
1. 12D/___=1	I am going to show fractions that equal one, but part of each fraction is missing.
2. 12/___=1	My turn to say the fraction that equals one: 12D over 12D. How do I know 12D over 12D equals one? Because the top and bottom are the same.
3. 2/___=1	My turn again: What fraction equals one? 12D over 12. How do I know it equals one? Because the top and bottom are the same.
4. ___/2=1	Your turn: Say the fraction that equals one. How do you know?
5. ___/17=1	Say the fraction that equals one. How do you know?
6. ___/3+R=1	Say the fraction that equals one. How do you know?
7. 100R/___=1	Say the fraction that equals one. How do you know?
8. ___/2=1	Say the fraction that equals one. How do you know?
9. 5R/___=1	Say the fraction that equals one. How do you know?

*Note:* Table 1 and 2 are taken from the book of *Theory of Instruction: Principles and applications* by Engelmann, S. & Carnine, D., 1991.

*Cognitive Strategies*

Kameenui and Simmons (1990) defined cognitive strategy as the process of using a series of simple facts, verbal chains, discriminations, concepts and rules together with the purpose of solving a problem. As a cognitive strategy contains various data such as concept and correlated-features sequence, students need to master these skills. Although the majority of the success of a student at school depends on recalling the information in exams and keeping them in mind is discussed, there are researches in literature regarding that cognitive strategies enhance the students' data-coding & memorizing skills, and contribute to the class performance of the students as well as their success in standard exams (Scruggs, T. E., Mastropieri, M. A., & Boon, R., 1998). Cognitive strategies need to be presented in a way to enable the student to reach high-level knowledge and generalization by using the previously-learned data (Gajria, M., Jitendra, A. K., Sood, S., & Sacks, G., 2007). Many skills taking part in math curriculum are cognitive strategy skills. Addition with multi-digit numbers (related skills: correlated-features sequence as addition with carrying if the number obtained after addition is not single-digit, discriminating the units, tens and hundreds digit, mastering the basic operations), hour-reading (related skills: counting up to 60 in fives, numerical reading, discriminating the hour and minute hand, past & to rules), calculating the slope of the line, etc. can be given as an example to the cognitive strategies which contribute to high-level thinking (Kozloff, 2004). Word problem solving skill is a cognitive strategy skill. Word math



problems require the utilization of well-known math skills to solve an unknown problem. As the instruction of calculation skills are prioritized in math, students have difficulty in solving math problems (Tuncer, 2009).

Cognitive strategies instruction is designed in a way to reduce the help of the teacher from the maximum structuring to the minimum structuring. In a fully-structured presentation, the teacher leads the students with the help of the simplifying questions and/or instructions in order to enable them to create a new skill by using the previously-learned concepts and skills. And then, the teacher reduces the questions and instructions to help the student be independent in using the strategy. For example, after teaching the correlated-features sequence as "if the first number of the divided is equal to or higher than the divisor, we underline the first number"  $\begin{array}{r} 420 \\ 2 \end{array}$  "if the first number of the divided is lower than the divisor, we underline the first two numbers"  $\begin{array}{r} 365 \\ 6 \end{array}$ , the presentation structured to do the process independently performs the process right after the worksheet practice structured by handing out the papers containing the division operations, as well as the worksheet practice less-structured by withdrawing the clues. It is observed that cognitive strategies instruction is an effective technique which is used in both acquisition and long-term recall of important data (Sener & Belfiore, 2005). An example of cognitive strategies instruction is given in Table 3.

Table 3. shows an example(2).

*Adding Two Numerals with Renaming*

TEACHER	STUDENTS
<b>PART A: STRUCTURED BOARD PRESENTATION</b>	
(Write the following problems on the board.)	
36+27=	
48+26=	
26+16=	
1. Read this problem as 1 point.	36+27=how many?
2. What column do we start working in?	The ones column
3. What are the first two numbers we are going to add?	6+7
To correct: Point to 6 and 7. Repeat step 3.	
4. What is 6+7?	13
5. We have a problem. Thirteen equals 1 ten and 3 ones. We can't have a 10 in the ones column, so we put the 1 ten at the top of the tens column. Where do we put the 10?(Write 1 over 3.)We write three ones under the ones column. Where do we put the three ones? (Write 3 under 7)	On top of the tens column. Under the ones column.
6. What are the first two numbers to add in the tens column?	1+3
What does 1 and 3 equal? (Pause)	4
Now what two numbers will we add?	4+2
What is 4+2?	6
How many tens do we end up with?	6tens
We end up with 6tens, so I will write 6 under the tens column. (Write 6 in the tens column)	
7. We are finished. (Point to 63) What does 36+27 equal?	63
Read the problems and say the answer. (Repeat steps 1-5 with remaining problems.)	36+27=63
<b>PART B: STRUCTURED WORKSHEET PRESENTATION</b>	
(Students have worksheet with the following problems.)	
45+38=	
57+37=	
36+16=	
47+26=	
1. Touch the first problem on your worksheet. Read the problem.	45+38=how many?

2. What column do you start working* What are the first two numbers you are going to add? What is 5+8? ( <i>Pause</i> )	The ones 5+8 13
3. There is a problem. What does 13 equal? Can we have a ten in the ones column? So where do you put the ten?  Write 1 on top of the tens column. ( <i>Monitor student responses</i> )  How many are left? Write them under the ones column. ( <i>Check</i> )	1 ten and 3 ones No On top of the tens column 13 equals 1 ten and 3 ones 3
4. Look at the tens column. What are the first two numbers to add in the tens column? What is 1+4? ( <i>Pause</i> ) Now what numbers will you add? What is 5+3? How many tens do you end up with? Write the tens under the tens column. ( <i>Monitor student responses</i> )	1+4  5 5+3 8 8 tens
5. You have finished. What does 45+38 equal? Read the problem and say the answer. ( <i>Repeat steps 1-5 with remaining examples.</i> )	83 45+38=83

#### PART C: LESS STRUCTURED WORKSHEET

(Give students a worksheet containing some problems that involve renaming and some that do not.)

47+25=	78+21=	
53+24=	56+36=	
42-31=	75-23=	
78+18=	26+43=	
1. Everyone, read problem one on your worksheet. What type of problem is this, addition or subtraction?		47+25 Addition
2. What are the first two numbers you add? What is 7+5? ( <i>Pause</i> )		7+5 12
3. Do you have to move a ten over to the tens column?		Yes
4. Now work the problem on your own. ( <i>Pause</i> )		
5. What does 47+25 equal? ( <i>Repeat steps 1-5 with remaining problems</i> )		72

*Note:* Table 3 is taken from the book of *Designing Effective Mathematics Instruction: A direct instruction approach* by Stein, M., Kinder, D., Silbert, J., & Carnine, D. W., 2005.

#### Discussion

In Direct Instruction model, the instructions presented in the lessons based on the association types simplify the teaching practices of the teacher. The teacher does not hesitate about the teaching process and knows exactly how to withdraw the clues and how to present the examples. In the model, the most significant characteristic of the instruction skills is that they do not vary from practice to practice and according to the personal styles of teachers. In Direct Instruction Model, the role of the teacher is specified and the instruction skills are practically defined (Altunay, 2008). In Direct Instruction Model, factors influencing the learning process can be categorized as designing the teaching curricula, selecting the examples to be presented and their sequencing, monitoring student progress and correcting student mistakes. When teachers consider the principles of Direct Instruction model, they can easily observe the changes in student behaviours (Engelmann & Carnine, 1991; Tuncer & Altunay, 2004). Furthermore, it is observed that the students are highly motivated and learn permanently as a result of the instructions which progress cumulatively. Also, it is very important to include the expanded teaching and worksheet items in Direct Instruction model, so that the students can master their math skills. Moreover, the teachers need to know how to conduct strategic integration into the subjects, how to review and evaluate, and how to apply the process of correcting mistakes in math classes.

The present study contributes to the literature on teaching math considering correlated-features sequence and cognitive strategy education based on Direct Instruction model in math skills of students with special needs. In this context, it is vital that students with special needs continue to be taught correlated-features sequence and cognitive strategy education as well as test-taking strategies. Although valuable attempts have been suggested in order to conceptualize how to gain access to the general curriculum for students with special needs, more efforts are necessary to fulfill the gap. Teachers need to take into consideration the process through which the educational programs of students with special needs. Overall, it is critical to use evidence-based practices in education in order to accomplish effective results from the curricula created for the education of the individuals with special needs. Evidence-based practices are the instruction techniques which fill the gap between research and practice, and which are supported with significant researches in terms of their efficiency in developing the acquisition of students (Slavin, 2002). Yet, teachers need to use more evidence-based practices in their classrooms. There is a need to build a bridge between the teacher's practice in class and the research that highlights the effectiveness of the practice (Carnine, 1997; Cook & Schirmer, 2006).

While many of the support services and accommodations that students with special education might create a dependent environment while providing the support (e.g., notetaking), strategies suggest independency by decreasing external assistance. Strategies help students in taking the responsibility of their learning. Furthermore, generalizing strategic learning skills in new situations might be helpful for the well-being of the individuals with special needs.

In conclusion, as math skills have a hierarchical structure math education needs to be designed in an effective way considering the requirements of the students with special needs. A well-designed and effective curriculum plays an important role, as well. In a review of research literature on the Direct Instruction model, it is noticeable that the Direct Instruction model differs from other models as it focuses on the generalization with long-term practices and the design of curriculum. In the present study, the Direct Instruction model is introduced as well as the significance and practices of the correlated-features sequence and cognitive strategies, which are the two of the association types described in the model, in math education.

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## DEVELOPING 21<sup>ST</sup> CENTURY SKILLS THROUGH PROJECT-BASED LEARNING IN EFL CONTEXT: CHALLENGES AND OPPORTUNITIES

Shree Prasad Devkota

Dhundi Raj Giri

Shiba Bagale

(Sustainable Development and Empowerment Forum/Kathmandu University)

spdevkota@kusoed.edu.np

### ABSTRACT

Learners learn the best when they are engaged in learning by doing. In order to cope with the 21<sup>st</sup> century problems, learners need to be prepared with 21<sup>st</sup> century skills and project-based learning can be one of the best teaching approaches to develop the 21<sup>st</sup> century skills. This article focuses on the discussion on project-based learning (PBL), 21<sup>st</sup> century skills, and role of teacher, 21<sup>st</sup> century learners, and 21<sup>st</sup> century schools as workplace, challenges and opportunities in Nepal as EFL context on the basis of research with five research participants. Furthermore, this research article can give a lot of insight about PBL and its challenges and possible opportunities using in EFL context in Nepal.

**Keywords:** Project-Based Learning (PBL), 21<sup>st</sup> Century Skills, school as workplace, role of teacher and learners, global issues, etc.

### INTRODUCTION

*“Tell me and I forget. Show me and I remember. Involve me and I understand.”*

As a Chinese proverb goes, it is widely accepted idea that learners learn the better when they are engaged in real life learning situation or experiential learning. So the learners’ engagement in the teaching learning activities play vital role in their learning achievement. More engagement of the students results in the higher achievement. So the learners’ engagement is very important in teaching learning practices. However, our context is quite contrary where teachers sweat in the classroom teaching and students remain passive listeners following orders and instructions of the teacher. As Defelice (1996) says, “Teaching in monolingual / mono-cultural, and non-English speaking environment at a time can be frustrating” (p. 43). Everything gets changed over the certain span of time. Today’s children are not going to learn as their parents did. Even the teaching learning methods we practiced in the past may not fulfill the needs and demands of our learners at this 21<sup>st</sup> century. Highet (2008) states, “Methods in any country alter every generation or so, as the structure and ideals of society alter”. To meet the ever-changing needs of students in the modern world, for the forward thinking educators, are crossing the traditional borders of their own disciplines to work with colleagues of other fields to develop novel approaches in teaching (Horn, stroller, and Robinson (2008, p. 2). Karn (2007) also mentioned that language teaching in general and English Language Teaching (ELT) in particular has tremendously changed over the centuries. In this dynamic world, in order to tackle the challenges of the new era in learners, project-Based learning (PBL) can be an effective in enhancing the learners’ learning achievement in EFL context.

### Project-Based Learning (PBL)

Project based learning is a practical and research oriented method of teaching in which learners are engaged in creating, building and testing what they have created or designed in collaboration with other learners; both inside and outside the classroom. According to Stripling, Lovett and Macko (2009), “Project-based learning is the instructional strategy of empowering learners to pursue content knowledge on their own and demonstrate their new understandings through a variety of presentation modes”. Students are engaged in different stages of activities for the task completion in which they go through in-depth investigation of the topic involving in interview, observation, internet surfing, etc for the collection of the required information for the study. Blank (1997), Dickinson, et al. (1998) and Harwell (1997) project-based instruction is an authentic instructional model or strategy in which students plan, implement, and evaluate projects that have real-world applications beyond the classroom ( as cited in North West Regional Education Laboratory (NWREL, 2002, p. 4). As project-based learning is more focused on students’ activities, they are involved in the planning, designing and implementing the project in real life situation in collaboration with the other co-learners and the teacher who provides scaffolding in their learning. “Learning activities are interdisciplinary, long term, and student centered, rather than short and isolated lessons (Challenge 2000, Multimedia Project, 1999 as cited in NWREL, 2002, p. 4). Students are engaged in such collaborative learning

in real life learning situation, they construct knowledge on their own. In such way, students' engagement in real life issues and collaborative approach can be essential for developing 21<sup>st</sup> century skills; communication and presentation skills, critical thinking, creativity, collaboration, research and technical skills, and time management skills, etc similar to the Pearlman (2006) who emphasizes on the 21<sup>st</sup> skills to cope with 21<sup>st</sup> century problems and issues. Therefore, the learners need to be equipped with these 21<sup>st</sup> century knowledge and skills. Moreover, it is, as Grant (2002) says, "learner-centered strategy that affords learners the opportunity for in-depth investigations of worthy topics and the learners are more autonomous" (p. 1). Therefore, student-centered strategy and varieties of activities integrated with real life problems and issues play vital role in enhancing the learning achievements in the learners.

However, the present textbook driven teacher-centered traditional teaching learning practices can not guarantee these skills in the learners. In such scenario, it is necessary to foster these skills in the young generation. Otherwise, they will be left far behind. As a result, our young generation will have to struggle to be the part of the globalized world. As Pearlman (2006) further says, "Societies need citizens who are smarter, more creative, and more capable of leading, managing, collaborating and networking with productive people around the world". Such smarter, creative and capable work force can be prepared only through providing them abundance learning opportunities in real life situation, engaging them in varieties of projects, where they work together with other fellow learners as per their needs and demands of time. So PBL, in such situation, can serve as an authentic strategy for enriching these 21<sup>st</sup> century skills in the learners.

### **School as Workplace for 21<sup>st</sup> Century Learners**

As students spend at least thirteen years of time in school from pre-school to secondary level (in Nepalese context), they bear a big responsibility to prepare the learners in for their life, fostering the required life skills. However, the traditional schools have not been as much productive as they should be because they have not been able to produce the efficient workforce required to tackle the problems in the 21<sup>st</sup> century. If the schools cannot guarantee these skills, it is just the waste of time, money and energy. It has been realized that our majority of School Leaving Certificate (SLC) graduates are lacking various skills needed to cope with the day to day challenges such as; communication, creativity, innovation, research and technical skills and so on. It is because there is the defect in our present teaching learning system where learners get no opportunity for independent learning environment, engaging them in creativity, critical thinking working in collaboration with their team. Schools, at present, consist of unmanageable number of students in congested classrooms, and taught through one way lecture method where students have to listen to their teacher passively. So this kind of teaching learning practices cannot bring the expected result. Therefore, it is necessary to change our schools or classroom as work place where student learn independently working in collaboration using not only the paper, pens and textbooks but also using varieties of technological tools. Therefore, it is necessary to revolutionize the teaching learning practices with large size classroom with sufficient teaching learning materials and they can work in team. In such situation, PBL can be a milestone for preparing students as global citizen with knowledge and skills to tackle the problems and issues in 21<sup>st</sup> century global market. As Pearlman (2006) says students should be provided working environment involving computers, group work, planning, presentations, team teaching, etc. Therefore, they are engaged in creating building and testing what they have made under the guidance of their teacher through scaffolding. Creating the efficient learning environment in the classroom is necessary to change the classroom situation as a work place where as Grant M. M. (2002) expressed that the learners are more autonomous as they construct personally-meaningful artifacts that are representations of their learning. (Grant M.M (2002, p. 1). Therefore, it is necessary to create the collaborative and interactive learning environment where the learners can construct new knowledge and skills working in collaboration. The classroom should be (Broz, 1999) family like environment where the students try to support each other. He further says that the class should be like a new adventure full of all kinds of new experiences through they can be able to develop new kind of relationships (p. 161).

### **21<sup>st</sup> century Learners**

The 21<sup>st</sup> century learners are smarter, dynamic and more informed. The learners today are flooded with information and options. They have connection with the people around the globe and they have access to the better contents (Perlman, 2010). Along with this scenario, they also have greater challenges to face to adjust in this century of the globalization. Therefore, the traditional teaching learning practices on the one hand, can not satisfy their needs and interests, on the other hand, can not develop the required knowledge skills needed to overcome the challenges of the 21<sup>st</sup> century. Then what can be the solution? Likewise, it is necessary to question our own teaching learning practices what sort of human resources are we going to produce tomorrow? Are they capable to compete in the 21<sup>st</sup> globalized context? In order to meet these various challenges, we need to engage the learners in creating, building

and testing what they have produced in collaboration on their needs and interests. Therefore, the kids today, as Pearlman (2006) said that they can become the smarter and also better communicators, collaborators, and performers for the workplace and society of the future.

### **Role of Teacher in PBL**

The world today is increasingly complex and fast-changing. So the role of education is to prepare the citizens who are smarter, more creative, and more capable for leading, managing, collaborating and networking with productive people around the world (Pearlman, 2006) to cope with those multidimensional problems today. The generation of such global human resource demands dynamic the role of the teachers. Smith (1999) opines that knowledge is best produced through exposure to the diverse source and mind sets (p.123), the role of teacher should be changed from authoritative to a facilitator, collaborator, manager, role model and co-learner who can create the learning environment encouraging the learners to work independently so they can construct the knowledge on their own. Bass (2001) expresses that teacher should not be the like the sage on the stage rather guide on the side of the learners giving the choices to their voices, work even outside the world to explore the complex issues and real life problems. Moreover, s/he should be able to engage them in meaningful learning activities where student can create something working in collaboration to each other about the problems. Similarly, Broz (1999) focuses on the collaborative role of the teacher. To be the collaborative teacher, he says that the scholar (teacher) should get down off the dais and dive in and swim with the students. However, this dive can be futile and scary if the scholar does not know what to do in that aquatic environment. Therefore, the teacher must know what to do: view students as developing scholar and be scholar with them (p. 157).

### **Data Collection**

In order to understand the teachers' perceptions and practices of PBL in Nepalese context and its scope in EFL context, we used a purposive sampling method to select our research participants. We selected five English language teacher professionals who have high level of academic degree, and long working experience as English language teacher, textbook writer, as well as teacher trainer in Nepal in EFL context. We used interview as our research tool to collect the data required for our purposed study. After the selection of the research participants, we interviewed them dealing with the research questions we had prepared hand but it was a semi-structured interview because we had other several questions to our participants beside the major research questions which were based on their experience and the issues they had raised in the course of interview. So that we could collect the rich data based on their knowledge and experience related to our research study.

### **Rationale of the Study**

Since PBL is very new in our context, even though the concept of PBL is not so very new in the west, there are very few English language teachers who know about project-based learning (PBL) in Nepalese context. Similarly, those who know about it, rarely use it in their classroom situation. So it is very hard to find the English language teachers who are familiar about PBL and used it in their classroom teaching. Therefore, it was my rationale for using purposive sampling and selecting these English language professionals as my research participants for this purposed study.

### **Research Questions**

In order to assemble the data required for our purposed study, we formulated a few research questions that can fulfill our research purpose. Though there were some subsidiary questions, our major questions were mainly focused on challenges and opportunities of using PBL in Nepalese context for developing 21<sup>st</sup> first century skills in the learners.

### **Data Analysis**

Here we have analyzed the data that collected by interviewing our five research participants who have been directly or indirectly involved in the field of teaching learning practices for more than a decade and working as teacher trainer, textbook writer for English language curriculum.

### **1. Challenges of PBL in Nepalese Context**

There is no doubt PBL in developing the 21<sup>st</sup> century skills required for the learners to develop themselves as the global citizens. However, it is not without challenges. In the course of interview, as response to my query about the challenges, my participant – 1 opined, “No skilled manpower is available to implement PBL in the classroom in Nepalese context”. We think, he is right because the concept of PBL in Nepal is a new and a few schools and



colleges have used it, actually not as the part of main teaching method rather as extracurricular activities. Therefore, it is very hard to find the skilled manpower with sufficient knowledge and skills, who can efficiently use it in the classroom teaching. Further, he said that curriculum has been based on textbook system. Teachers are compelled to follow the curriculum so there is difficulty in using the PBL in their course. Adding to his statement, Participant - 2 said that our curriculum is old and traditional. Of course, this is the reality that even though various teaching learning strategies have been emerged and implemented in the field of education, nevertheless, our teaching learning is still based on old tradition. Teaching learning activities have been still limited on one way lecture method where teacher sweats teaching in the classroom and students do nothing except listening to the boring lectures of their teachers and a few bright students taking some notes and questioning to their teachers in case of confusion. Therefore the learning outcome is still low. Due to such monotonous classroom activities, the learning motivation is also low. Dealing with the same issue, participant – 3 also opined concerning the factor of time management. It is because our teaching curriculum is based on fixed textbooks which teachers must complete within the allocated time frame so while following those textbooks. They can't go beyond the classroom for such project-work even though they are very important for maximizing the learning outcomes of the learners.

Unlike idea of Bass (2001) about the role of teacher, participant – 2 quite contrarily said, “We teachers are the sage on the stage but not the guide on the side of the students which is the great hindrance to implement PBL”. It is the reality that even though they have got very long experience of teaching but they are not able to address the interests of the students providing them freedom in exploring the things outside the classrooms problems according to their interests, and need so that they can construct the knowledge on their own working with other students in collaboration which can be reason that students' drop out ration is very high in our country. Further, he added that there are various emerging trends and issues in ELT and even though we are master's or PhD degree holders, we are not very aware about such things. He is right from my experience, we are theoretically sound. We can have big talk about the different teaching theories, however practically we are still backward when the practical kinds of things come before us.

Regarding this issue, participant – 3 who has got double degrees (Nepal and the U.K.) in English, also put his view that it is also difficult to use it in rural area because there is difficult to find out professionals to provide the relevant information. Further, he said, “There is also lack of the resources, professionalism in teachers who can create such learning environment”. Another burning challenge in implementation of PBL is the lack of resources, especially in rural areas where it is very hard to find out the resourceful person to make the in-depth study of subject matter under study. Similarly, it is another bitter reality that most of the teachers lack professionalism, research and technological skills and study habits. Rather they take this teaching profession as time pass so that they don't have to be jobless unless and until they do not get other opportunities. Likewise, participant– 4 regarding this issue, put his view that students have to go to the field and library to collect the data. In-depth study lies in the heart of PBL. Time and again, students have to visit the library, search on the internet, and field visit for data collection but the reality is that most of the schools do not have library. Even though, some of them have, they are not equipped with the sufficient resources so they are maintained just for show. PBL is useful in terms of as Pearlman (2006) says in generating smarter, more creative, and capable manpower by managing, collaborating and networking with productive people around the world. However, finding the teachers, as participant - 4 further expresses, is challenging in our context who can successfully handle the project in teaching learning activities.

Similarly, participant– 5 who is English teacher and teacher trainers pointed another genuine challenge in our context that students most of the students feel difficult while going through PBL because they are habituated in traditional kind of classroom teachings. Participant – 2 again in this issue expressed that there are several teaching training programs held from and various private organizations in the different intervals of time, they have not been able to address the current issues and trends in ELT.

## 2. Opportunities of PBL in Nepalese Context

As everything has both dark and bright side, so does PBL too. Even though there are lots of challenges in the successful implementation of the PBL in classroom teaching but it does not mean it is not possible in the context of Nepal in EFL situation. Participant- 1, in response to our question about the opportunities of PBL in our context, expressed that present pattern of curriculum needs to be changed in ord to use the PBL but initially we need to localize the project in our local context in order to develop creativity in the students. Similarly, participant - 2, for the successful implementation of the PBL, focused on the school leaders. He said that if the principal is strong and has clear vision in implementation of the project work, then PBL can be easily implemented. We think, the success

of any organization depends on its leader and his/her leadership quality. It is a very genuine issue that if the principal of the organization has good knowledge and skills and clear vision about using PBL in schools, providing all the requirements; resources, trained human resources, then PBL can be not only be successful but also can achieve higher level of benefits for students and teacher and the organization as well. Like Meganathan (2011) says when learners work together on a particular idea / topic, they collect information, ideas, observe language being used, use language in real life situations, exchange views and debate on ideas, write the ideas into a report, edit their writing and produce the report in a suitable form. As Project work is interdisciplinary in nature where students get opportunity to develop various skills while going through various project works so learners can be benefited by developing various skills like communication skills, management skills, critical thinking, and technical skills and so on.

In the same way, participant – 3 also expressed his view regarding the benefits of students. He said as group work is the very essential part of PBL, students get opportunity to work in team that helps them to develop the interactive, communicative and collaborative skills at the same time. Moreover, there is active learning which encourages the learners for the research based activities that develop their research and problem solving skill etc. Participant – 4, adding to it, said, “Project is an integration of everything because it deals with every aspects of the topic”. He further said that it develops students’ level of confidence, critical thinking and social skills working inside and outside the classroom situation. Actually his idea of project is really noteworthy since group collaboration lies in the heart of project work which provides the learners and ample opportunity to work both inside and outside the classroom situation. The learners are engaged in varieties of works according to the nature of varieties of projects which enable them to develop the most essential skills like collaborative skills, time management skill, critical thinking, technical skills, research and social skills and so on which are known as 21<sup>st</sup> century skills. In the same way, as they get opportunity to work outside the classroom in team according to their interests, they are more excited to undergo through the project work where they have to go for field visit in order to collect the data. It provides the learners with higher level of learning outcome. Adding to it, participant – 5 said that PBL can be very useful to get the real life experience outside the classroom. Working outside the classroom is another essential feature of PBL, especially in real life experience so that learners can develop their critical thinking and problem solving skills. Working in/outside the classroom, visiting the field, PBL provides an opportunity as chard (2014) shares her opinion that Project learning is in-depth learning in which children can take some ownership of their work and through which they have choices that they can make -- but choices that are designed together by the child and the teacher so they're not entirely whatever the child wants to do but choices from among alternatives.

### **Implications of the Study:**

The concept of PBL is a new concept in the Nepalese context. This research study is made based on the findings and conclusions based on intensive interview of our five research participants who have been directly or indirectly involved with the PBL in their teaching learning pedagogy as an integral part of their classroom teaching. Based on the ideas they have expressed, finally we could draw the following implications. We are hopeful that these implications would be helpful for me as well as any EFL teachers as well as other subject teachers their for effective teaching learning practices, providing the opportunities for the learners to learn with real life experience outside the classroom engaging them in meaningful learning. Moreover, it can be also very useful for those teachers, educators, policy makers, teacher training experts who have been exploring the ways to bring out changes in the present teaching learning system. Similarly, it will also help to the learning in a different learning environment.

1. The study revealed that PBL is a new concept in educational practices which provides opportunities for the learners to work in/outside the classroom working in collaboration.
2. PBL is an interdisciplinary in nature which provides the opportunities for the learners to develop various 21<sup>st</sup> century skills.
3. The pattern of curriculum and classroom needs to be changed to create the learning environment for the 21<sup>st</sup> century learners.
4. The traditional classroom should be developed as a workplace equipped with necessary equipments for the 21<sup>st</sup> century learners.
5. The role of teacher must be transformed from authoritative to facilitator, coordinator, initiator, guide working with the students and student from passive listeners to co-workers, meaning makers, active learner, team builder, manager etc.
6. There are various challenges of using PBL in Nepalese context along with its opportunities.

## CONCLUSION

As this research article deals with PBL which is a very new concept in teaching learning system in the context of Nepal. PBL is a modern, research based and practical teaching learning approach which provides an ample opportunity for the learners to work along with the guidance of the teacher who provides them with necessary scaffolding. So the role of teacher and student is quite different in comparison of the traditional classroom. Teacher plays the role of facilitator, guide, co-learner, co-worker manager who creates the learning environment for the learners whereas the role of students is also to be active learner, meaning maker and so on. The traditional congested classroom needs to be transformed as a work place with sufficient space so that students can perform various activities working in collaboration. Even though there are various challenges in using the PBL in the classroom in Nepalese context, PBL can be successfully implemented in teaching learning practices managing the necessary pre-requisites; the sufficient learning resources and skilled human resources.

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## DEVELOPING SCIENCE PROCESS SKILLS AND SOME OF ACCOMPANYING SKILLS THROUGH OBSERVATION OF LIFE CYCLE OF SILKWORM BY KINDERGARTEN CHILD

Shaymaa Shawkey Elkeey  
Faculty of Kindergarten, Department Of Basic Sciences  
Master Program of Preschool Education  
Alexandria University, Egypt  
shaimaelkeey@gmail.com

### ABSTRACT

This research targeted to develop science process skills and some of accompanying skills through observation life cycle of silkworm by kindergarten child. For achieving this purpose the researcher began this work with the study of the science process skills, accompanying skills, observation, life cycle of silkworm and the relation between them through access to the educational literature and the previous studies and research. Two research questions and thirty two hypotheses guided the research. The hypotheses were tested at  $p \leq 0.01$  level of significance. The pretest and posttest experimental and control group design was used for the search. A sample was consisting of 34 preschoolers randomly selected from star baby kindergarten – Tanta district was used for the research. The experimental group was taught science process skills and some of accompanying skills using the program based on observation of life cycle of silkworm, while the control group was exposed to lecture method. Three validated instruments called scale of science process skills; two note cards for science process skills and some of accompanying skills. Accordingly, it was concluded that observation life cycle of silkworm by kindergarten child was important for the acquisition and development of science process skills and some of accompanying skills.

**Keywords:** Science Process Skills; Accompanying Skills; Observation; Kindergarten Child; Life Cycle of Silkworm

### INTRODUCTION

The development of the human element in the society from the strategic priorities of the countries that are planning to the future and often these countries begin to prepare and develop her human capital from the first stage of childhood and which is considered a critical and an important stage during which the formation and crystallization perceptions and ways of thinking of the child and his interaction with the world around him. In light of this, the past few decades have witnessed a significant shift not in educational trends, and began to clear interest in teaching thinking, this means that need has become an urgent for children to learn to think And process and skills, it is therefore the development of scientific thinking skills in children of basic goals, which education seeks to it generally and, in particular, the teaching of science in all phases Education.

Both (Coral Campbek & Wendy Jobling , 2012, P. 31) indicate that Kindergarten teacher needs to challenge the children's understanding by providing different experiences, and challenge Child to rethink or understanding, and provide them with a number of rich and diverse experiences And development through discussions and a lot of questions appropriate to their understanding of scientific concepts .

(David Jerner Martin, 2001, p. 9) illustrates that science process approach encourages children to exercise science and apply in their investigations there are also information which kicks off for children To use what they discovered from operations and learn mainly Through its use in finding new scientific phenomenon.

(Ghadeer Ibrahim, Et al., 1998, p. 6) see that kindergarten children like scientists because, they maintained the exercise of their expertise and scientific activities of them as young scientists, and this what supports the importance of the development of scientific thinking skills among kindergarten children as, these skills remain with them until the joined the school, and for this matter countries of the world interested in the development of scientific thinking skills among kindergarten children.

(Heidi Gerard Kaduson & Charles E. Schaefer, 2006, p. 84) see that there are behaviors such as participation and gratitude - and support needed to discover and practice as accompanying skill. And through interactions with other child learns social skills in addition to accompanying language and mental skills (K. Eileen Alleen & Glynnis E. Cowder, 2010, p. 386).

(Susan J. Kovalik & Karen D. Olsen , 2010, p. 95) illustrate that senses help the child to observe by screening the information leaned directly from the senses, which enables him to build from the perspective of the

world and the initial observation knowledge to draw many restricted information and works as a precondition and requirement based on the environment. Which is consistent with what (Huda mahmoud Elnashef ,1997, p . 69) said about the importance of learning through senses and stated that the doctor philosopher John Locke, who was believed that the environment and sensory experiences which the child pass through it will determine what he will become, not inherent abilities of the child inside him . He has imagines Child's mind at birth with a blank sheet of embossed upon knowledge and children are just outcome of these experiences. John Locke and his followers especially Maria Montessori believed that the best way to benefit from available expertise the senses of child are trained as windows that enter by it knowledge. The effect of this theory is that the interest in the development of the senses of the child continued to this day as we notice in many of programs in the kindergarten and the tools, materials that are designed specifically for children of this stage in order to train the senses.

(Judy Cusick , Andrew Cocke & Betty Smith , 2006 , P. 124) indicate that observation, classification and discussion help the child to learn a lot about the types of insects and the characteristics, habits, also entertaining facts and learn the role that insects play in our world. As the study each of (Dalia Abdel Wahed , 2004; Samia Mohammed Jawish , 2004; & Hanem Mahmoud Gabr , 2005) confirmed that the kindergarten child's has ability to observe and describe change which occurs in the body of the insect. This is consistent with what stated in (Australian curriculum science , 2011, p. 22) children need to observe, discuss and record stages of the life cycle of silkworm by using brief observations and depending on investigation skill that include questions, prediction, planning, conclusion process, analysis of data, information and communication.

As stated above, the most effective thing that enables kindergarten child to gain science process skills and some of accompanying skills is observing life cycle of silkworm.

### **Purpose**

This study has two purposes. The first to Develop Science Process Skills through observation life cycle of silkworm by kindergarten child, and the second is to develop some of accompanying skills through observation life cycle of silkworm by kindergarten.

### **Research questions**

Two Research Questions of the research in relation of the purpose of the research are as follows:

1. What's the impact of a program based on the observation kindergarten child's life cycle silkworms to develop the skills of scientific thinking all alone on the scale and on the level of scientific thinking skills as a whole?
2. What's the impact of a program based on the observation kindergarten Children to the life cycle of the silkworm on the development of accompanying skills with each separately and on the level of note card as a whole?

### **Research hypothesis**

Research hypotheses formed from two main hypotheses, first main hypothesis includes twenty -seven related to each sub-skill of science process skills. While the second main hypothesis includes three special sub-hypotheses for each skill of accompanying skills.

1. There is a statistically significant difference at the level of significance "0.01" between the average scores of the experimental group and the average scores of the control group in the post to the science process skills scale favor of the experimental group.
2. There is a statistically significant difference at the level of significance "0.01" between the average scores of the experimental group and the average scores of the control group in the post to the accompanying skills note card favor of the experimental group.

### **METHOD**

In this study, a basic experimental study using pre test and post test was designed, in addition to descriptive method.

### Pilot study

Fifteen preschoolers from (5-6) years, who were not included in the study, participated in a pilot study. The pilot study revealed that:

1. The program based on observation life cycle of silkworm and its activities were appropriate to the children.
2. The children hadn't any previous experience about life cycle of silkworm.
3. The children were wondered by silkworm and interested in observing it.
4. The children loved the program activities and incorporated in it, and during the show of silkworm feeding, the conversation between two children happened, one of them stated that "I feed silkworm three leaves, and other child said I feed silkworm two leaves".
5. The children involved in discussion that occurred between them and researcher.
6. Instruments of study were validity and reliability.

### Sample

In this study, two groups were used: one experimental (17 children) and the other control (17 children). Random selection or sampling of preschool was done to obtain the sample. The research used sample consisted of (34) preschoolers from baby star kindergarten – Tanta district during the 28/4/2013to2/7/2013 academic years, spring semester.

### Instrumentation and Analysis

Science process skills scale was administered to both experimental and control group. The research used instruments:

Science process skills scale was prepared by researcher: to measure both basic science process skills and integrated science process skills which has 27 dimensions and consists of (56) items, 5 items related to observation, 4 items related to classification, 2 items related to measuring, 1 item related to communication, 2 items related to operation questions, 4 items related to using time/ space relationships, 3 items related to use numbers, 1 item related to sense realize, 3 items related to prediction, 2 items related to inferring, 3 items related to experimenting, 2 items related to formulating models, 2 items related to cause and effect, 2 items related to conclusion, 1 item related to Formulating Hypotheses, 2 items related to interpreting data, 3 items related to description, 1 item related to drawing, 1 item related to investigation, 2 items related to comparison, 2 items related to cooperation, 1 item related to estimation, 2 items related to analyze, 1 items related to control variables, 1 item problem solving, 2 items related to generalize, 1 item related to summarizing and multiple choices, two note cards were prepared by researcher for science process skills consists of (108) items and accompanying skills consists of (27) items, (3) basic accompanying skills (art of rearing silkworm – scientific work rules – scientific conversion) and (8) sub- skills (manipulative skill – hand eye coordination – skill related to Characteristics of life – skill related to health education (hygiene) – skill related to using lenses hand – skill related to time management- general skills – skills related to cooperative work) with reliability coefficient of (.985), (88.3), (89.6) respectively and Wechsler preschool intelligence scale (1999), scale of the economic and social level of the Egyptian family consists of (9) items and was developed by Abdulaziz Alshakhs (2006) to determine the equivalence between two groups before the treatment.

Three checklists were prepared by researcher for rating scientific attitudes of kindergarten children consists of (10) items, a checklist for rating practice science process skills inside the classroom consists of (8) items and a checklist for rating parent's attitudes toward practice science at home consists of (12) items, with reliability coefficient of (.966), (.763), (.922) respectively. Validity was ensured by involving supervisors in examining the tools. The Treatment For The Research Involved:

1. Teaching the Experimental Group Science Process Skills And Some Of Accompanying Skills Using The Program Based On Observation Of Life Cycle Of Silk Worm.
2. Teaching the Control Group the Same Science Process Skills and Some of Accompanying Skills Using Traditional Method. After The Treatment, Which Lasted For Two Months, The Post Test Was Conducted.

When children's pre- science process skills scale and pre-note card for accompanying skills scores were used as a covariate, ANCOVA was used To test the research questions and to determine the treatment effect on children's post- science process skills scale scores and post - note card for accompanying skills scores. Data was analyzed using SPSS version (17).

**RESULTS**

To determine the science process skills and some of accompanying skills of the groups, a t-test, Analysis of Covariance, Effect Size and Eta Squared ( $\eta^2$ ) were made, and due to the no responses to the two groups of children in pre- test so analogy condition has achieved between two groups of children. Results statistics for posttest scores for the control and experimental groups on science process skills scale and note card for some accompanying skills are given in tables.

Table 1: Illustrates the value (p relative) and statistical significance in science process skills scale as a whole in posttest for the two groups

$\eta^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.995	0.01	1535.48	5240.52	4	20962.08	Rate model
0.828	0.01	139.53	476.23	1	476.23	Section
0.367	0.01	16.84	57.50	1	57.50	Attitudes of children
0.058	0.192	1.78	6.09	1	6.09	Attitudes of parents
0.126	0.50	4.18	14.27	1	14.27	Attitudes of teacher
0.93	0.01	361.27	1233.01	1	1233.01	Group
			3.41	29	98.97	Error
				34	48280	Total
				33	21061.05	Rate total

Table 1 shows significant treatment effects on children's science process skills ( $p$  cultivated = 361.27 at the level of significance "0.01" on science process scale as whole in posttest. and the effect size of program based on observation of life cycle of silkworm in developing science process skills as a whole = 93 % ,this percentage was high effect .

Table 2: Illustrates the rate means for the two groups of study in science process skills scale as a whole in posttest

Rate mean	Group
50.19	Experimental group
6.39	Control group

As seen in table 2 : comparing the rate means scores of children's performances in both the experimental and control groups in science process skills scale as whole with respect to posttest .

Table3: Illustrates the value (p relative) and statistical significance in cause and effect skill in posttest for the two groups

$\eta^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.758	0.01	22.69	5.32	4	21.30	Rate model
0.000	0.96	0.002	0.00	1	0.00	Section
0.044	0.25		0.312	1	0.312	Attitudes of children
0.071	0.14	2.21	0.519	1	0.519	Attitudes of parents
0.00	0.95	0.004	0.001	1	0.001	Attitudes of teacher
0.06	0.21	1.68	0.394	1	0.394	Group
			0.235	29	6.80	Error
				34	48	Total
				33	28.11	Rate total

Table 3 shows significant treatment effects on children's cause and effect skill ( $p$  cultivated = 1.68 at the level of significance "0.05" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing cause and effect skill = 6% ,this ratio was weak effect .

Table 4. Illustrates the rate means for the two groups of study in cause and effect skill in posttest

Rate mean	Group
1.15	Experimental group
0.37	Control group

As seen in table 4 : comparing the rate means scores of children's performances in both the experimental and control groups in cause and effect skill with respect to posttest.

Table 5: Illustrates the value ( $p$  relative) and statistical significance in conclusion skill in posttest for the two groups

$\chi^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.894	0.01	60.96	7.31	4	29.25	Rate model
0.026	0.384	0.782	0.094	1	0.094	Section
0.182	0.017	6.45	0.774	1	0.774	Attitudes of children
0.001	0.885	0.021	0.003	1	0.003	Attitudes of parents
0.00	0.995	0.00	4.69	1	4.69	Attitudes of teacher
0.13	0.05	4.39	0.527	1	0.527	Group
			0.12	29	3.47	Error
				34	61	Total
				33	32.73	Rate total

Table 5 shows significant treatment effects on children's conclusion skill ( $p$  cultivated =4.39 at the level of significance "0.05" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing conclusion skill = 13% ,this ratio was medial effect .

Table 6: Illustrates the rate means for the two groups of study in conclusion skill in posttest

Rate mean	Group
1.36	Experimental group
0.45	Control group

As seen in table 6 : comparing the rate means scores of children's performances in both the experimental and control groups in conclusion skill with respect to posttest .

Table 7: Illustrates the value ( $p$  relative) and statistical significance in cooperation skill in posttest for the two groups

$\chi^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.912	0.01	75.11	6.44	4	25.77	Rate model
0.044	0.256	1.34	0.115	1	0.115	Section
0.287	0.002	11.69	1.003	1	1.003	Attitudes of children
0.024	0.409	0.702	0.060	1	0.060	Attitudes of parents
0.00	0.972	0.001	0.00	1	0.00	Attitudes of teacher
0.12	0.05	4.01	0.345	1	0.345	Group
			0.086	29	2.48	Error
				34	53	Total
				33	28.26	Rate total



Table 7 shows significant treatment effects on children's cooperation skill ( $p$  cultivated =4.01 at the level of significance "0.05" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing cooperation skill = 12% ,this ratio was medial effect .

Table 8: Illustrates the rate means for the two groups of study in cooperation skill in posttest

Rate mean	Group
1.21	Experimental group
0.48	Control group

As seen in table 8 : comparing the rate means scores of children's performances in both the experimental and control groups in cooperation skill with respect to posttest .

Table 9: Illustrates the value ( $p$  relative) and statistical significance in estimation skill in posttest for the two groups

$\chi^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.792	0.01	27.64	1.66	4	6.64	Rate model
0.061	0.180	1.88	0.113	1	0.113	Section
0.013	0.544	0.37	0.023	1	0.023	Attitudes of children
0.004	0.723	0.128	0.008	1	0.008	Attitudes of parents
0.00	0.988	0.00	1.40	1	1.40	Attitudes of teacher
0.17	0.05	5.98	0.360	1	0.360	Group
			0.060	29	1.74	Error
				34	15	Total
				33	8.38	Rate total

Table 9 shows significant treatment effects on children's estimation skill ( $p$  cultivated =5.98 at the level of significance "0.05" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing estimation skill = 17% ,this ratio was high effect .

Table10: Illustrates the rate means for the two groups of study in estimation skill in posttest

Rate mean	Group
0.815	Experimental group
0.067	Control group

As seen in table 10 : comparing the rate means scores of children's performances in both the experimental and control groups in estimation skill with respect to posttest.

Table11: Illustrates the value ( $p$  relative) and statistical significance in analyze skill in posttest for the two groups

$\chi^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.835	0.01	36.82	5.33	4	21.33	Rate model
0.087	0.11	2.76	0.401	1	0.401	Section
0.125	0.05	4.15	0.602	1	0.602	Attitudes of children
0.029	0.36	0.86	0.125	1	0.125	Attitudes of parents
0.066	0.164	2.04	0.295	1	0.295	Attitudes of teacher
0.14	0.05	4.71	0.683	1	0.683	Group
			0.145	29	4.20	Error
				34	52	Total
				33	25.52	Rate total

Table 11 shows significant treatment effects on children's analyze skill ( $p$  cultivated =4.71 at the level of significance "0.05" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing analyze skill = 14% ,this ratio was medial effect .

Table12: Illustrates the rate means for the two groups of study in analyze skill in posttest

Rate mean	Group
1.39	Experimental group
0.36	Control group

As seen in table 12: comparing the rate means scores of children's performances in both the experimental and control groups in analyze skill with respect to posttest.

Table 13: Illustrates the value ( $p$  relative) and statistical significance in generalize skill in posttest for the two groups

$\chi^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.875	0.000	50.87	6.02	4	24.09	Rate model
0.066	0.162	2.06	0.244	1	0.244	Section
0.211	0.009	7.74	0.917	1	0.917	Attitudes of children
0.006	0.684	0.169	0.020	1	0.020	Attitudes of parents
0.010	0.601	0.28	0.033	1	0.033	Attitudes of teacher
0.11	0.063	3.74	0.444	1	0.444	Group
			0.118	29	3.43	Error
				34	54	Total
				33	27.52	Rate total

Table 13 shows significant treatment effects on children's generalize skill ( $p$  cultivated =3.74 at the level of significance "0.05" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing generalize skill = 11% ,this ratio was medial effect .

Table14: Illustrates the rate means for the two groups of study in generalize skill in posttest

Rate mean	Group
1.29	Experimental group
0.46	Control group

As seen in table 14: comparing the rate means scores of children's performances in both the experimental and control groups in generalize skill with respect to posttest.

Table15: Illustrates the value ( $p$  relative) and statistical significance in accompanying skills as whole in posttest for the two groups

$\chi^2$	Significance level	P	Mean squares	df	Sum of squares	Source
0.998	0.01	4420.53	16500.67	4	66002.69	Rate model
0.93	0.01	386.08	1441.15	1	1441.15	Section
0.008	0.63	0.237	0.884	1	0.884	Attitudes of children
0.02	0.43	0.636	2.37	1	2.37	Attitudes of parents
0.001	0.89	0.016	0.061	1	0.061	Attitudes of teacher
0.097	0.01	1325.39	4947.33	1	4947.33	Group
			3.73	29	108.24	Error
				34	134422	Total
				33	66110.94	Rate total

Table 15 shows significant treatment effects on children's accompanying skills as whole (p cultivated = 1325.39 at the level of significance "0.01" in posttest. and the effect size of program based on observation of life cycle of silkworm in developing accompanying skills = 97% ,this ratio was high effect.

Table16: Illustrates the rate means for the two groups of study in accompanying skills as whole in posttest

Rate mean	Group
88.69	Experimental group
0.95	Control group

As seen in table 16 : comparing the rate means scores of children's performances in both the experimental and control groups in accompanying skills as whole in posttest.

It is seen from the tables that experimental group values are higher than the control group values, when compared to the rate mean for the two groups of children from (5-6) years on science process skills scale except for tables (3,4,5,6,7,8,9,10,11,12,13,14) related to cause and effect skill, conclusion skill, cooperation skill, analyze skill and generalize skill. In addition experimental group values are higher than the control group values, when compared to the rate mean for the two groups of children from (5-6) years on accompanying skills note card .

## DISCUSSION

The first objective of this research was to compare the effect of program based on observation life cycle of silkworm on developing science process skills , kindergarten children from (5- 6) year- olds .

The results given in Tables 1, 2 suggest that the values about the experimental groups are higher than those about the control groups when comparing the rate Average scores both experimental group and control group got about their science process skills. Except for tables (3-14) related to cause and effect skill, conclusion skill, cooperation skill, analyze skill and generalize skill.

Results of the research are consistent with results of similar studies previously conducted.

Research of (Haigh et al, 2005) about the acquisition of Science process skills science through a live programme that has helped children to be aware of the relevance of Science in their lives. After the programme, children perceived an improvement in applying Science process skills.

Many researchers have shown that hands-on activities incorporating Inquiry based science teaching to science instruction will improve science Attitudes and science process skills (Staver & Small, 1990)

(Anderson, 2002) states that the previous studies indicate employing inquiry based science teaching in science education has some positive effects on cognitive achievement, process skills and attitude towards science.

(Aktamis & Ergin, 2008) found in their study to teach scientific process skills to students to promote their scientific creativity, attitudes towards science, and achievements in science.

(Peggy T.Gordon , 2006) reached that Daily integrating science process skills and developmentally appropriate "hands-on" science experiences into a constructivist preschool classroom had an impact on students' readiness skills for kindergarten.

In order to develop scientific thinking in children (Lloyd and Howe , 2003) have mentioned the importance of developing different thinking skills that can provide scientific thinking rather than adopting approaches that directly target scientific thinking. Moving from there and as is proven in this study; it can be assumed that various thinking skills such as induction, deduction, and problem solving contribute to a general scientific thinking skill.

(Jenny Cheng Oi Lee Et Al., 2012) found in their study Science process skills and logical thinking abilities are factors that can influence children' concept learning in science.

The results of this research indicated that scientific thinking skills of children differ according to age. It can be concluded that scientific thinking skills improve with age. The reasons of this can be the increase in children's experiences and their mental maturing with age.

In this context this result that concluded from this research agreed with results of studies as follow:

(Ozgal polat unutkan, 2006) found in her study scientific thinking skills of children differ according to age. Scientific thinking skills of 5 year-old children are insufficient compared to that of 5.5 and 6 year-olds.

(The national academy of education, 2013) has shown that children begin to show signs of higher-level thinking skills as young as age 4 ½. Researchers have previously attributed higher-order thinking development to knowledge acquisition and better schooling, but the new longitudinal study shows that other skills, not always connected with knowledge, play a role in the ability of children to reason analytically. Children's executive function has a role in the development of complicated analytical thinking. Executive function includes such complex skills as planning, monitoring, task switching, and controlling attention. High early executive function skills at school entry are related to higher than average reasoning skills in adolescence.

On the other hand, the results of this research indicated that the traditional methods weren't effective in teaching science process skills for pre-scholars. In this context (Karah Et Al., 2004) Children understand best when they do activities themselves; working with and playing with real objects. They hardly benefit from listening and watching passively as the teacher talks or demonstrate without them taking an active part Children learn through doing. Children attempt to understand the world around them by observing, hearing, exploring, experimenting and manipulating. The teacher should always realize that science is doing not just being told and therefore children should be actively involved in learning (Nyoroh, Sayles & Munguti, 2003). Young children learn best through the senses. They learn when they look, listen, touch, taste and smell. A child understands concepts when presented in form of real objects, actions and situations (Njenga & Kabiru, 2007).

In this context (Anna Pits, 2013) indicated that using multiple senses allows more cognitive connections and associations to be made with a concept. This means it is more easily accessible to your children.

The second objective of this research was to compare the effect of program based on observation life cycle of silkworm on developing some of accompanying skills, kindergarten children from (5- 6) year- olds.

The results given in Tables 15, 16 suggest that the values about the experimental groups are higher than those about the control groups when comparing the rate Average scores both experimental group and control group got about their some accompanying skills.

The findings of accompanying skills were agree with the pre-school teacher's activity guide (KIE, 2004), which requires the teacher to develop simple experiment which children can understand and do on their own. The activities and materials should be organized in such a way that children come up with their own discoveries. The teacher should give each child a chance to contribute to his or her learning. Pre-school science activities help children explore and understand world around, satisfy curiosity and get answers to questions.

The findings were supported by (Josephine Rutere& Kathure, 2011) that a child should be active participant in learning where they are the doers, the materials are the tellers and the teacher is the guide. The children cannot learn by only sitting and listening to the teacher. Therefore the teacher should allow and encourage the children to explore, investigate, discuss, play, model and practice science activities. Children need real life experiences because they are unable to think through ideas. They need to see and touch for themselves.

According to (Rai & Richardson, 2003) teaching or learning aids are intended to provide children with real life experiences. Children have an opportunity to use their full senses (touch, sight, smell, hear and feel) to enhance learning. This helps in conceptualization of otherwise abstract ideas and helps understanding mastery and retention of the ideas or concepts. So, (K.I.E, 2003) pre-school teachers' activity guides series said that "Science activities are learnt best through inquiry."

(Rosalind Driver et al, 2011) stated that Practical activities help a child to investigate, view such as using lens, modeling and measuring. The teacher needs to prepare the practical in advance and if necessary try them out before the lesson. Learners should be given clear instructions before the lesson. These activities will help the child to learn social skills and respect others; start developing some concepts in science and skills which are vital for 'learning, understanding and appreciating' sciences as a subject in later years.

## CONCLUSIONS

From the results of this research, the following conclusions were drawn:

It can be developed science process skills and some of accompanying skills through observation life cycle of the silkworm by kindergarten child. Science process skills of children differ according to maturity. Thus in addition, teaching science using traditional methods, children should be involved in own investigations in the science. Science is largely a doing subject and children know more of what they do than what they hear. They need see touch, smell and do as much as possible of their own investigations. They are unable to think through ideas and therefore hands on activities and first hand experiences make learning better for them. The teacher should give each child a chance to contribute to learning.

### Recommendations

The researcher recommends the following based on the findings and conclusions: Children's process skills along experimenting, observing and communicating should further be developed through varied science Activities and projects. Other process skills should also be enhanced and mastered. School administrators and kindergarten teachers should plan and initiate science-related activities to enhance science process skills development among children. Enhance teaching skills of kindergarten teachers by conducting in – service trainings or sending them to seminars, workshops or lectures. Similar studies can be conducted with a greater number of schools to verify the findings of the research. Other science process skills and factors encountered Children's in developing science process skills can also be included if necessary. Administrators and kindergarten teachers should work for higher children's proficiency by continuously studying and enriching the science curriculum programs to cater to the development of the science process skills of the children Kindergarten teachers should develop a deeper interest and love in teaching science so as to give the children what is expected of them, they should master what they teach .similar studies can be conducted to develop the generalization skill, cause and effect skill, analysis skill, conclusion skill and cooperation skill by kindergarten child.

### Research Proposals

Through the research results we can suggest the following research:

1. The effect of program based on investigation of scientific phenomena on thinking patterns of kindergarten children.
2. The effect of program based on investigation of scientific phenomena in developing parents' attitudes toward science education at home.
3. Some factors affecting the use of science process skills by Kindergarten children.
4. Science process skills knowledge and attitude among kindergarten Teachers in Alexandria city: a pilot study.

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# DIGITAL TECHNOLOGIES, LEARNING AND SCHOOL: PRACTICES AND PERCEPTIONS OF YOUNG CHILDREN (UNDER 8) AND THEIR PARENTS

Rita Brito | [britorita@campus.ul.pt](mailto:britorita@campus.ul.pt)  
UIDEF, Instituto de Educação, Universidade de Lisboa

Patrícia Dias | [pdias@fch.lisboa.ucp.pt](mailto:pdias@fch.lisboa.ucp.pt)  
Centro de Estudos em Comunicação e Cultura, Universidade Católica Portuguesa

## ABSTRACT

This article explores the practices and perceptions of young children (under 8 years old) and their families about the use of digital technologies at school and their potential for learning, as well as the articulation between formal learning at school and informal learning at home. Data was collected through activities with children and their families, and then we used qualitative content analysis to explore them. The results show that the use of digital technologies at school is more common in Primary, being rare in Preschool. However, the pedagogical potential of devices like computers and tablets is underexplored both in schools and at home. Parents consider that children under 8 are too young for using digital tools in school work and believe they are not prepared to do so yet (although children are actually tech-savvy).

**Keywords:** Young children (under 8), school, digital technologies, learning.

## INTRODUCTION

Our society is profoundly shaped by the integration of digital technologies in our daily routines. Children are being born in homes filled with computers, smartphones and tablets, and they come into contact with such devices increasingly earlier. However, most research on children and digital practices has focused older children, mostly adolescents, who soon stood out as pioneers and trendsetters in the use of media as the internet and mobile phones. Our research fills this gap (Plowman, 2015; Vatavu *et al.*, 2014) by studying the practices and perceptions of younger children, and also their parents, as important mediators of their contact with digital technologies at this age. Concerning the use and impact of digital technologies in formal learning, the literature is as vast as inconclusive. Research acknowledges advantages and disadvantages of using digital technologies for learning, and identifies skills and domains in which their effects are positive, and others where they are negative (e.g. Lieberman *et al.* 2009; Hsin *et al.*, 2014). A significant strand of this literature focuses High School and University students, as it only became more common for young children to have access to digital technologies recently. There is also a focus on the computer, the first digital tool to be integrated in formal learning, also because it is common for University students to have their own laptop (e.g. Lai, Wang & Lei, 2012; Audi & Gouia-Zarrad, 2013; Lee & Wong, 2014; Gurung & Rutledge, 2014).

Some claims are rather consensual within the academia. On the one hand, children coming into contact with digital technologies at an early age is unarguable and possibly unavoidable (Kucirkova, 2011). Parents are the ones who facilitate the first experiences and learning, and who also set an example (Livingstone, 2007; Plowman *et al.*, 2008). On the other hand, there is an increasing discrepancy between the children's domestic environment, filled with digital devices and multimedia stimuli, and the traditional formal learning system. As consequence, children's attention span is decreasing, they may develop negative attitudes towards school, and their fine motricity is revealing changes, adopting gestures related to touch-screen devices to approach paper (e.g. McKenney & Voogt, 2011; Nacet *et al.*, 2014).

Facing this scenery, it is important to gain further knowledge on young children's digital practices, in particular the ones related with school and formal learning, as well as the parental mediation that contextualizes them. This will allow a more informed and fruitful discussion about the use of digital technologies at school as tools for learning.

## 1. STATE OF THE ART: DIGITAL TECHNOLOGIES, LEARNING AND SCHOOL

### 1.1 Digital homes *versus* traditional schools

Currently, children are being born in digital homes and receiving stimuli from digital media from an early age. Besides the traditional television, which still occupies an important role in their lives, young children are attracted to their parents' smartphones and tablets. Parents, whether because they wish to share with their children digital

activities that they enjoy, whether because they need to keep the children entertained, they allow the use of these devices, and may even acquire consoles and tablets for the children (e.g. Plowman *et al.*, 2008; Genc, 2014; Lauricella *et al.*, 2015).

The home environment, highly stimulating for all senses at a fast pace, frequently contrasts with the traditional school, particularly since Primary, where children are asked to sit quietly for long periods, to write with pen and paper, and to focus on activities as reading and calculating. There is, therefore, a deep contrast between these two settings, and the school is usually disfavored in children's perceptions, as some of them describe it as boring and monotonous (Levy, 2009; McKenney & Voogt, 2010). Even in Preschool, the habits previously acquired at home are different from the activities proposed to the children. For instance, concerning fine motricity, children prefer to use their finger to paint and draw, discarding pencils and paintbrushes, and they approach books with the same gestures they use for tablets (Nacher *et al.*, 2014). Even so, Saçkes *et al.* (2011) show that digital skills acquired at home favour the children's performance in Preschool.

Some studies (e.g. Levy, 2009; Saçkes *et al.*, 2011; Blanchard & Moore, 2010) present an argument shared by many teachers: it is necessary to introduce digital technologies in schools, not only because of the advantages they may bring to learning, but mostly because they are an additional motivation for children, and their use alone contributes to perceiving school in a more attractive way. About the way these technologies should be introduced and their impact in learning, the literature is far less consensual (e.g. Lankshear & Knobel, 2003; O'Rourke & Harisson, 2004; Hsin *et al.*, 2014).

## 1.2 Digital technologies and learning

Graham (2008) coined the term "digiteacher" to characterize teachers who use digital technologies in the classroom, and describes their profile. Age is determinant, these teachers are generally young and had contact with digital technologies at an early age - they are Prensky's (2001) digital natives (O'Bannon & Thomas, 2014). Besides, they have a strong online presence, are informed about tools and platforms, and enjoy using them (Graham, 2012). On the contrary, older teachers (mainly over 50 years old) are reluctant to use digital technologies in the classroom. In the middle, there are many professionals who, although they use digital tools, they do not take advantage of all their potential, as they tend to use them for tasks that they did previously using other tools. For instance, the most common activity is using the laptop to play music, as they would do with a CD player (Yurt & Cevher-Kalburan, 2010).

Even among "digiteachers", their will to integrate digital technologies in the classroom and their creativity are restrained by syllabus that they have to cover and by existing digital platforms and content, that do not always meet the expectations of children, or are enjoyable for them. For instance, the computer is the digital device more frequently used in schools while the tablet is preferred by children at home. In the tablet, the favorite activity is playing games, in particular those that are related to the fictional universes that children like the most, like characters from movies and cartoons or toys (Fleer, 2014; Merchant, 2015). At school, children are asked to engage in other type of games and activities, as the most common uses for the tablet in the classroom are apps related with stories (ebooks or storymaking) (e.g. Hoffman & Paciga, 2014; Ihmeideh, 2014; Kucirnova *et al.*, 2013;), apps for drawing and digital collages (e.g. Crescenzi, 2014), and apps with maths exercises (McEwen & Dubé, 2015).

Research shows that the impact of digital technologies in learning may be both positive and negative, that is, digital technologies favour the development of certain skills but are not as useful regarding others. For instance, some studies report positive effects in acquiring decision-making and problem-solving skills (Kim & Cho, 2013; Falloon & Khoo, 2014; Price *et al.*, 2015), in developing critical reasoning (Wood & Jocius, 2014), in gaining independence (Chou, 2013), in working collaboratively (Kucirnova *et al.*, 2014), in socially interacting with peers, parents and teachers (Roberts-Holmes, 2013) and even in expressing emotions (Tanyel & Knopf, 2011). Ihmeideh (2014) reports that learning how to read was easier for preschoolers using ebooks when compared to another group using book. Nacher *et al.* (2014) and Neumann & Neumann (2013) highlight the development of fine motricity by using touch devices. McEwen & Dubé (2015) show that using the tablet increased the attention span of preschoolers and their concentration in tasks, bringing added-value to several learning activities. On the other hand, research has also showed that children memorize more easily the name of letter and the alphabet when they study in paper (Wolfe & Flewitt, 2010; Willoughby *et al.*, 2014).



Hsin *et al.* (2014) present a systematic literature review about the effects of introducing digital technologies in the teaching of young children. After reviewing 87 articles, the authors conclude that there are more positive effects than negative, mostly related to the social dimension of child development - children become more collaborative, they relate better with peers and adults, and they are more tolerant to difference. So, the competences and skills that digital media favour, although extremely important, are not the ones highlighted in syllabus.

Hence, the debate about using digital technologies in classrooms does not call for a “yes” or “no” answer. On the contrary, digital technologies can and should be integrated in classrooms in parallel or additionally to other techniques and tools, and used strategically to develop and reinforce the skills for which they are more suitable (Lieberman *et al.*, 2009). For instance, Yokota & Teale (2014) and Javorsky & Trainin (2014) compare the use of school manuals in paper and digital, and conclude that ebooks are more suited to images and animations, as they enable interactivity, while paper is preferred for text. Ott & Pozzi (2012) study the use of game-based learning apps in Preschool, reporting high success. The role of the teacher is thus fundamental as it is up to him to manage the use of digital technologies in the classroom (Blanchard & Moore, 2010).

### 1.3 Family, technologies and school

Several researchers agree that, at such an early age, although children are capable of exploring digital technologies independently, they often need guidance and help. The role played by parents is fundamental, as they are the first mediators. It is with parents that children usually engage in their first digital experiences, and they regard them as role models, tending to replicate their practices and preferences (e.g. Bittman *et al.*, 2011; Kucirnova & Sakr, 2015; Livingstone, 2007; Plowman *et al.*, 2008).

The same applied to the role of the teacher, that assumes the mediation in the school context, stimulating and guiding the children (Couse & Chen, 2010; Neumann & Neumann, 2013). Research shows that the perceptions and attitudes of teachers, and their training regarding digital technologies, as well as their digital literacy, are determinant to foster a positive use of these resources in the classroom (Blackwell *et al.*, 2014; Graham, 2012). So, the intrinsic barriers of teachers - perceptions, attitudes and skills - are the most determinant ones, instead of extrinsic factors such as access (Blackwell *et al.*, 2013).

School plays a timid role when it comes to using digital technologies for learning. Considering that parents and Preschool and Primary teachers play as mediators of digital technologies for young children, it is surprising that research on this issue reports a lack of articulation between families and schools (e.g. Plowman *et al.*, 2012; Kim & Choo, 2013). The activities performed in these different contexts are often disconnected. Parents do not resort to digital technologies to support studying or for pedagogical purposes. They regard digital devices as toys, that children predominantly use for playing. At school, during Preschool and most of Primary, teachers do not take advantage of digital technologies, they do not involve families in digital activities or tasks, and they do not explore the full potential of numerous platforms that mediate and facilitate communication between school and family. Research by Grant (2011) about the perceptions of parents, children and teachers about an integrative digital platform for schools and families reveals that it pleased them all. However, parents and children expressed concern about the delimitation of frontiers between the school and family spaces and dynamics, revealing that this articulation must be well thought, managed and balanced.

## 2. METHODOLOGY

### 2.1. Research questions

In this article, we explore the following questions: 1) Which digital practices associated to formal learning do children under 8 years old have?; 2) Which kinds of skills result from those (formal and informal) learning digital practices at home?; and 3) What are the perceptions of children and parents about the use of digital technologies for learning and in school?

### 2.2. Empirical Methods

In this study, we followed a qualitative approach, as its main goal was describing and developing an understanding about a particular situation (Burns, 2000; Creswell, 2007; Glesne, 1999; Goodwin & Goodwin, 1996). Qualitative researchers are interested about the meaning of phenomena, about how individuals make sense of their world, about how each of them experiences life and interprets those experiences (Bogdan & Biklen, 1994). Thus, we went “(...) to the field (...)” and researched about “(...) what people are doing and thinking (...)” about the issues we wanted to study (Strauss & Corbin, 1996: 11).

For exploring the data, we used thematic content analysis. According to Braun & Clark (2006), thematic analysis is a method that identifies, analyses and relates themes (patterns) that emerge from the data. It also allows to organize them and describe them in detail, also implying the interpretation of several aspects concerning the themes under study. In this research, we chose to build a detailed description of all the data - a portrait of each family, based on an inductive thematic analysis. Thus, all the themes identified are strongly related to the rough data. After clarifying these procedures, it is also important to mention that we followed the 6 phases of thematic analysis, a process that involves going back and forth in our analysis of the data. These 6 phases are the following: 1) familiarizing with all the data - transcriptions, reading and re-reading, taking notes about the main ideas; 2) creating initial codes - coding interesting features of the data systematically and confronting the relevant data with each code; 3) searching for themes - grouping the codes in potential themes, joining all relevant data for each possible theme; 4) reviewing all the themes - checking the themes by comparing them with the initial codes (phase 1), and generating a map of thematic analysis; 5) Defining a naming the themes - this analysis perfects the specificity of each theme and how it fits the "whole story", generating clear names and definitions for each theme; and 6) writing the report - the integration of all the analysis in clear descriptions, relevant excerpts, and using examples to answer the questions that guided the research, thus producing a final research report. For categorizing the data, we used the software QSR NVivo 11 Plus for Windows.

The main method for collecting data were semi-structured interviews to parents and children, together and separately. Several supporting techniques were developed to facilitate the data collection and to stimulate the participation of children. We interviewed a set of 25 families with children aged from 3 to 8 years old, that used at least one digital tool at least once a week. We used coding techniques during the interviews in order to get more data and being able to generate more accurate and detailed descriptions (Strauss & Corbin, 1990, 1998).

For selecting our sample, we used theoretical sampling in order to obtain a wider range of narratives about the use of digital technologies for learning (Strauss & Corbin, 1990, 1998). Theoretical sampling aims at representativity, not of the population, but of the concepts being studied, thus maximizing the opportunities for identifying and comparing situations, and later categories. However, the proportions in the sample and of the categories may vary according to their properties and dimensions. Maximizing and promoting the opportunities for comparing concepts, taking into account their features and similarities, allows the researchers to make their categories more compact and diverse, specifying its variability (Corbin & Strauss, 2008: 202).

Thus, we intended to interview a set of families with children between 3 and 8 years old, that used at least one digital device at least once a week. We searched for variability in our sample, regarding: i) gender of the child; ii) composition of the family (divorced parents, with and without siblings, etc.); iii) socioeconomic level (highlighting the participation of lower levels). The families were selected among personal contacts and in support institutions, as a Social Center and a Parish Center. All the families approached were receptive to our requests. The visits to the families were scheduled by telephonic contact, at the convenience of the family. The interviews took place between June and November 2015.

These visits included different activities: in the beginning, the family was interviewed together, aiming to get to know the daily routines of the child, and they were asked to fill a daily schedule with stickers with varied activities; then, simultaneously, one of the researchers interviewed the parents while the other talked to the child (and siblings, if they existed). The interview to the child was complemented with different activities, such as a card game about favorite activities, the identification of apps from a standard grid and a 'digital tour' where the child was asked to show the researcher his or hers digital devices, spaces of use and preferred activities. The data was registered in audio files, photographs and notes taken by the researchers about their participant observation.

### **2.3. Participants**

We interviewed 25 Portuguese families, with children from 3 to 8 years old. All the families and their members were coded in order to ensure their anonymity and the confidentiality of the data. The coding for each family member starts with the initials of the country - in our case PT - Portugal - and numbered from 1 to 25. Next, we added the role played by each one in the family (f for father, m for mother, g for girl, b for boy) and the age.

## **3. DESCRIPTION AND DISCUSSION OF THE DATA**

In this section, we present a description and an analysis of our data. The questions issues presented are findings of our thematic analysis, and not questions that we posed to our families.

### 3.1. Digital technologies used at school

Among the children interviewed, 9 claimed not to have any digital technology in their classroom and even school. Among the other 16, 11 were in the 1st or 2nd year of Primary, and three of them mentioned using the computers in the school's library and a digital board in the classroom. Among the children in Preschool only 5 referred having a computer in their classroom or school.

### 3.2. Activities using digital technologies performed by the children at school

We present in Table 1 the learning activities using digital technologies mentioned by children and parents.

**Table 1:** Use of digital technologies by children under 8 in formal learning.

Children under 6 years old (Preschool)	Educational games and casual <sup>1</sup> games in the computer
	Writing in a text processor
	Research to support projects
	Computing classes (writing in a text editor, drawing in an image editor, playing games)
Children from 6 to 8 years old (Primary)	Playing games in the library computers
	Using the computer in the classroom (although most times it is used exclusively by the teacher)
	Using the tablet (as a manual and as a support to study tool)
	Do not have computers at school but visit places like libraries so that children can use them
	Computing class (games, searches)
	Search musics and videos

As Table 1 shows, in Preschool, the children that have access to digital technologies use the computer to play educational games related to reading and writing, or casual games. They also write their name and colleagues' names in the text processor, and draw in the image editor pictures that teacher later print for them to paint. Two children told us they use the computer to search for projects they do in the classroom.

*PT17Gg5: I search for butterflies, I also search... It's about what's on the plan for the day.*

This kind of activity was also mentioned by parents.

*PT14Dm: (...) this year, they did a project about photography in which they took pictures, and then selected the best ones, the worst, focused and defocused... that was one of the projects they did this year in her classroom.*

The discourses of children and parents allow us to realize that the Preschool teachers of these two children that have more contact with digital technologies use constructivist methodologies, that is, teaching methods that promote autonomy, and children can participate actively in building their knowledge and learning.

Among the older children, in Primary, we found more children - a total of 10 - with access to computers in school, whether in the classroom or in the library. In the library, 3 children reported playing games related to cartoon characters such as Spider-Man and Ninja Turtles, and watching videos on YouTube. One of them told us that although she has access to the internet in the library computers, they only have permission to access images and not videos. In fact, in all Portuguese public schools, since 2014, the Ministry of Education limited the access in all networks to some social networks and services, claiming that it was a measure to prevent hacking attacks and slow

<sup>1</sup> Casual games are games directed at users that do not wish to dedicate much time or effort playing them. To progress in these games, the requirements are low, and yet they allow the user to increase the challenge by trying to accomplish tasks faster or through rewards. Usually, these games are colorful, have attractive graphics and sounds, do not include content with possible negative connotations such as violence and confrontation, and reward the player with small but frequent prizes, building constant motivation to play.

connections. Thus, the access to Facebook, Tumblr, Instagram, and Android and Apple stores are limited from 8:30 a.m. to 1:30 p.m. Apart from this time-frame, there is a daily limit for browsing. The updates on Windows operating systems are only possible from 5:00 p.m. to 8:00 a.m. The access to YouTube does not have a schedule limit, only a limit for the amount of data transferred (Bancalero, 2014).

In the classroom, it is frequent that only the teacher uses the computer. The children are only allowed to use it when they finish their other activities, and one at a time, they use the interactive board for additional schoolwork.

*PT4g9: The teacher uses the computer and sometimes we do activities, when we have time. There is a place for activities and revising what we studied and we... go in line (...) we go to the board and do it.*

Although they can use the computers in the library to play, some children prefer to play outside with their classmates, playing football (mostly boys), instead of going to the library and use the computer to help them with their homework or for entertainment.

Only one child, age 7 years old, said that he used the tablet as a support for classes at school, which is a private institution. Even though the mother bought him a computer, he prefers to perform activities such as searches and digital presentations in the tablet. He connects it to the projector in the classroom and presents his work.

*PT22m: PT22b7 needs it [the tablet] for school, it is a manual (...). [He] has a computer in the bedroom because of homework and such, but he does not pay attention to it, he doesn't use it, he prefers to do all his homework in his iPad. (...) At school, he presents with the projector. (...) On Sunday (...) we were all at the house, with his grandparents, with friends, (...) and he was online searching and then did a presentation and presented it at school (...). [The mother picked up the son's tablet and showed some of his works to the researcher] This is the "Lands of Portugal" [title of the assignment]... This is what he did on that day. He did it alone. (...) He went to the internet alone to get information, placed it here, and did the assignment by himself.*

School, by stimulating the autonomy of children when it comes to using digital technologies, makes them more autonomous and motivated to search about their interests, and in this case, for schoolwork.

Some schools that don't have access to digital technologies, as computers, organize regular trips or events that allow the children to have this access. For instance, PT25g6's Kindergarten went to the "Citizen Store", a place that aggregates public services, and they used a computer room for a whole morning to "play in the internet" [PT25m]. Also, PT21g7's class went to the nearest Secondary School in order for all children to use the computers.

Five children have computing classes, two preschoolers and three in Primary. In computing class, they use Microsoft Paint, write in the text processor and play games.

*PT18b5: In computing class I do: I play games, I look at the board and try to imitate what is in the board, letters, letters and more letters.*

Yet, one of the mothers refers that the son is not interested in using the computer at home, nor in reproducing what he learns in computing class, he prefers to play with the tablet. This device is the favorite of most children to play with at home.

In computing class, children from the 1st year of Primary also play in the computer, search online and mentioned "doing the login" [PT7b6], hinting at more specific activities, such as using the internet and registering online in some websites.

*PT10g6: I learn to go to Microsoft, saving my work, getting images from the internet.*

*I: What is Microsoft?*

*PT10g6: Where you can work. (...) Sometimes, when we finish those assignments, we can play. The work we do on the computer is that, get images from the internet. In the last one, we had to pick wild animals and animals we can have at home.*

*I: How did you get those images from the internet?*

*PT10g6: I wrote "lion" and then I went to the image and it showed up on the screen. I pressed the left button of the mouse, and then it showed up "copy image".*

PT6m claimed that her and the father considered computing class very important for the future of their son, and that was why they chose to pay for extracurricular computing classes at school.

*PT6b7: This year he started in computing class but we have to pay for it. (...) now we use computers for everything (...) and as we can't teach him that [the mother and the father have low digital literacy], we thought it would be good for him (...) to have that activity.*

Digital technologies are also used in a more free and playful way at school, in the context of ATL<sup>2</sup> (Activities for Free Time). Older children use the computer for listening to music and they teach the younger ones to search, and sing together, thus revealing collaborative learning.

*I: And she knows how to search for things alone [in the smartphone]?*

*PT3m: Here [in the smartphone] she knows. (...) But (...) the other day I saw her... she picks up the smartphone, goes on YouTube, and listens to Taylor Swift, (...) the artists (...) that are currently fashionable for teenagers (...) And I ask her "How did you do that? [search for the songs]" and she laughs and says "Because I already know how to do it". (...) I think it all started over there at school, in the school's ATL, because at the end of the day, one day I picked her up, they were all on the computers, and some older girls, they teach the younger ones, and they learn.*

### **3.3. Activities (involving some type of learning) using digital technologies performed by children outside school**

We summarize on Table 2 the learning activities using digital technologies outside school that children and parents referred.

**Table 2:** Use of digital technologies for informal learning.

Children from 6 to 8 years old (Primary)	Searches for homework
	Following search suggestions in the school manual
	Installing and using pedagogical apps (e.g. reading, writing, maths)
	Using pedagogical software in the computer (e.g.. virtual school books)

These activities are usually performed at home, by children in Primary, accompanied by their parents. The parents and children under 6 years old did not mention any of these activities in the home. However, it is common that parents resort to the internet to explain concepts and doubts for their children, although most children do not show yet any motivation to search online on their own.

*PT2m: Sometimes, when we need to explain him something that he doesn't know, we do it with the internet. Let's imagine that he asks 'what is this?' We go to Google and search. But although we do that, he does not have the initiative yet, searches are always driven by us.*

On the other hand, there are children who use digital technologies autonomously for their homework.

*PT4m: PT4g9 does it [search online], as she has her own tablet (...) she goes to her bedroom and searches whatever she needs to search, and does her homework.*

Although less frequent, some parents mentioned other types of educational activities using digital technologies, such as following search suggestions in school manuals, using school manuals in ebook format for homework or studying, installing pedagogical apps and using pedagogical software.

*PT2f: But on the other day we searched with him [PT2b7] because of his homework. (...) The school manual said the homework and required an internet search. It was about animals or something like that.*

*I: And do you try (...) to install games that are connected to school in any way, that are educational?*

<sup>2</sup> Activities available in schools to fill free time, if parents are not able to pick children up right after classes.

*PT2f: We do not make a habit out of it, but if we find something that we can do I install and try to get him to play with it.*  
*PT2m: Yes, but we could explore that more.*

Besides, the “digital tour” to the children’s tablets showed us that only one girl had pedagogical apps installed, namely one for learning English and ebooks. All the others only have games, and their most common activities in these devices are playing those games and watching videos on YouTube.

### 3.4. Use of children’s personal digital devices at school

In order to overcome the lack of digital technologies in school, children might eventually bring their own devices to class. However, that is not case. Most schools do not allow children to bring their digital devices to classes.

*I: At school do you use your computer or tablet?*  
*(...)*  
*PT3b7: I can’t, not even in ATL. They don’t allow me.*

*I: Do you usually bring your tablet to school?*  
*PT9g7: The teacher doesn’t let me. (...). I think she is afraid it might get broken during the break.*

Although some schools forbid students from bringing their own devices, some parents disagree with this rule, acknowledging that the devices might promote some skills.

*I: And to the school, can he bring it [the tablet]?*  
*PT10m: No [laugh]. (...) They told me they are not allowed to bring digital devices, and this year they said that of they [the children] do bring them, they are not responsible. I think it isn’t normal that they do not feel accountable for what happens in school. But the break is a time when they can play with each other, fantasize, create... (...).*

On the other hand, some parents show concerns about their children bringing digital devices to school, they worry the children may break them or damage them in any way. Despite these prohibitions, some children do bring their personal devices to school. For instance, this is the case on Fridays in the ATL where PT18m works. Children are not allowed to take photos of each other, but some do not comply and the caretakers must search their devices and delete them if they find any.

*PT18m: (...) At our school, on Fridays, we let them bring the tablets for ATL. We are not accountable for any device. The funny thing is that they are forbidden to take photos of each other. (...) Some obey this rule, but we end up having to reprimand those who are bolder and want to take a photo, and then there we go... The operating systems are different and we have to try and figure out how to delete the photos! [laughs] Even Nintendo’s take photos, and I do not know how to use a Nintendo! Everything is digital!*

### 3.5. Explanations for not using digital technologies more used to support formal learning

Most parents assumed not using digital technologies for any educational activities because they claim not having felt the need to do online searches with their children yet, add that it might be too soon, as school has not stimulated that kind of practices by requiring them as homework.

*I: Does she need any of these technologies for school?*  
*PT8m: Not really, not yet, but the school year has just started. But I am already organizing for [PT8g15] (...) to spend some time with her brother and explain him those things. (...) I have told her: “[PT8g15] (...) you have to take at least 20, 15 minutes off, to teach [PT8b6] how to use the computer”, because he doesn’t use the computer, she doesn’t let him. (...) I think that will be very important.*

*PT3m: Concerning school I did not feel that need yet. When this need stars, I am sure more time will be spent on the laptop than on the tablet. I’ll have to bring the laptop [from work] (...) or have a laptop at home for her to do her homework, because I am sure that will be the evolution. Doing her homework in the laptop. But not for now, we are still pretty archaic here at home.*

One mother feels that her daughter does not have enough maturity to do those searches, and prefers not to engage in such activities with her.

*I: (...) Do you do any searches on Google with her?*

*PT3m: No. Not yet, because... I don't know! (...) I think she does not have yet... she does not absorb. And she runs away a lot.*

Another mother shared that, in spite of her son asking some questions to which she answers that they will search when they get home, that promise is usually forgotten.

*PT1m: (...) in theory, sometimes he asks questions and I say we should search online... The other day he asked how bridges over rivers were built underwater, and I said we could search about that on the internet when we got home. But then in practice, we get home and he forgets, those are questions that he just remembers at the time.... Only rarely did we really go search on Google (...).*

At last, there is a mother who recognizes that she would like to explore more pedagogical mobile apps that her son could use on the tablet, but that would require some time for searching, selecting and stimulating him to actually use them, and she does not have that time. So, she lets her son choose for himself, and he always prefers games related to cartoons and movie characters that he likes.

### 3.6. Perceptions concerning digital technologies, learning and school

The main barrier to the exploration of pedagogical digital content at home is the perception, shared by parents and children, of digital technologies as a source of entertainment, as “toys”. Parents consider that children under 8 years old are still too young and have a limited use of such tools - which isn't always true, as children, even without knowing how to read or write, develop complex strategies for searching, selecting and playing, are aware of a varied array of apps, and are able to perform complex tasks. Besides, parents resort to tablets and smartphones as an effective way of keeping children entertained, mostly when they are busy with domestic chores or work, and they do not dedicate much time to exploring these tools with them. Using the computer is often not allowed to children, as parents perceive it as a work tool.

Also for children, digital technologies are “toys”. A mother even describes the tablet as her daughter's “best friend”. Usually, they benefit from some freedom and are able to choose their favorite activities. Most of the parents monitor the apps installed in the children's devices, and some forbid violent games or content that they evaluate as inadequate for their children's age. Most of the children prefer games related to fictional characters that they already know and like, from cartoons and movies (such as Disney's princesses and Spider-Man), or as toys (such as Barbie and Lego). Some parents question what can be considered learning, arguing that children are always learning when they use the tablet or the console, although they are acquiring skills different from those in school syllabus. For instance, these parents mention hand-eye coordination, a predisposition to problem-solving with and trial-and-error approach, and the ability to make independent decisions, as well as to search and select information.

## 4. CONCLUSION

This study aimed to know better the digital practices of children under 8 years old related to formal learning at school, as well as the parental mediation that contextualizes them, related to practices of informal learning at home. These questions were explored comparatively, considering two age groups: children between 6 and 8 years old, in Primary; and children between 3 and 5 years old, in Preschool.

At school, although both age groups have access to digital technologies, these are more present in Primary than in Preschool, namely computers and interactive boards. Between 2005 and 2009, the Portuguese Ministry of Education, through its Education Technological Plan (PTE), had the goal of technologically modernizing all public schools, concerning in particular the 2nd and 3rd cycles of Secondary school, by equipping schools with internet connections, video-projectors and interactive boards. The average of computers with internet connection per student went from 17,3 in 2001/2002 to 3 in 2014/2015 (DGEEC, 2015). Although Primary and Preschool are not directly covered by these measures, the 1st cycle of basic education (Primary) sometimes benefits indirectly from these measures.

In both cycles, the activities performed at schools are alike, being mostly playful and educational games on the computer. In Primary, some of the children play and do some online searches at school, mostly in the school's library, as in the classroom the computers are used almost exclusively by the teacher. At Preschool, children also

play on the computers. Kindergarten teachers that use the computer as a support for learning are the ones that prefer constructivist teaching methods. These methods place the student in the “center” of the activity, and thus make it easier for him/her to benefit from the pedagogical potential of technology (Ertmer & Ottenbreit-Leftwich, 2010). However, our main conclusion is that, both in Preschool and Primary, schools are far from exploring the full potential of digital technologies, either in the classroom, either for articulating with families (e.g. Levy, 2009; McKenney & Voogt, 2010). Only one child from Primary has reported using the tablet daily at school, as a manual and for researching. Consequently, this child is very autonomous in searching about his interests (Mei-Ju, 2013), reveals developed critical reasoning (Wood & Jocius, 2014) and is an example of the effects of using this device for learning (Kim & Choo, 2013; Falloon & Khoo, 2014; Price *et al.*, 2015). This child attends a private school.

Computing classes are included both in Preschool and Primary, as a way of sensitising the students and parents for the importance of using the computer, but only as an extracurricular activity. The parents who decide to enrol their children in this activity share positive perceptions towards digital technologies, believing that they will be important work tools in their children’s future.

Concerning informal learning at home, some of the parents of children in Primary help them in online searches regarding schoolwork. On the other hand, others assume not using digital technologies at all, because they weren’t needed so far. Besides this occasional articulation with school, most parents do not explore the pedagogical potential of digital devices at home, in particular the tablet’s. Parents perceive this device as one more “toy” and do not favour the choice of pedagogical apps, letting the children choose freely the content they prefer. Parents justify this attitude with lack of time, lack of interest from the children and lack of content in Portuguese. Thus, they use the tablet mostly as a babysitter, to keep the children entertained on their own while the parents are busy (e.g. Flear, 2014; Merchant, 2015). Even so, some parents consider that entertainment with tablets and consoles also generates learning, but of skills different from those on school syllabus.

In sum, although children live with a panoply of digital devices at home, and despite the Portuguese Ministry of Education and Science’s effort to equip schools with digital devices, their use with educational purposes is insipid both at school and at home. Besides, practices at school are very different from the families’ uses (e.g. McKenney & Voogt, 2011; Nachet *et al.*, 2014). Thus, the main barriers to a better exploration of the pedagogical potential of digital technologies is not access or skills, but the perceptions of teachers, parents and children (e.g. Yurt & Cevher-Kalburan, 2010; Blackwell *et al.*, 2013, 2014). It is necessary to rethink Education in this digital age, re-conceptualizing schools and classrooms. The strategies must be constructivist, reassessing the traditional approaches and methodologies of teachers and also syllabus, in order to promote better learning environments.

#### **LIMITATIONS TO THIS STUDY AND FUTURE RESEARCH**

Interviewing children so young was real challenge for the researchers, and led us to develop games and create strategies to earn their trust and make them comfortable. However, some of the children were more timid, and sometimes all we got as answers from them were nods. In order to deal with this, we believe further studies are needed with a longitudinal character, allowing several visits to the same families. Besides making children more comfortable with the researchers, we would also be able to observe the development of their digital practices as they grow up.

Interviews are very rich as a data-collecting method, as besides registering our conversations with all the family members, we were also able to observe the environment in each home and the interactions and dynamics in each family, which wouldn’t be possible with a survey. Yet, transcriptions and coding are a time-consuming and exhausting task, making it difficult to work with wider samples. An interesting option would be the realization of a wider survey (preferably representative) in articulation with interviews.

#### **ACKNOWLEDGEMENTS**

This article reports partial findings from a wider project coordinated (and partially funded) by the Joint Research Center of the European Commission. Also, the Research Centre for Communication and Culture from the Catholic University of Portugal has also partially funded the research in Portugal (FCT PEst-OE/ELT/UI0126/2013).



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# EFFECTIVENESS OF DIRECT INSTRUCTION MODEL IN ACQUISITION AND MAINTENANCE OF GEOMETRIC SHAPE CONCEPTS FOR STUDENTS WITH VISUAL IMPAIRMENT

Banu ALTUNAY ARSLANTEKİN

Ulviye ŞENER AKIN

<sup>1</sup> Special Education Program, Gazi University, Ankara, Türkiye

<sup>2</sup> Special Education Program, Gazi University (Ph.D. Cand.), Ankara, Türkiye

For correspondence: [ulviye\\_2000@yahoo.com](mailto:ulviye_2000@yahoo.com)

## ABSTRACT

The purpose of this study is to investigate the effectiveness of Direct Instruction model in acquisition and maintenance of geometric shape concepts for students with visual impairment. Three 1<sup>st</sup> grade students attending an urban primary public school for visually impaired students participated in this study. The design of the study is a multiple probe-across-participants design. Criterion-referenced tests were developed and conducted to assess the sphere concept in participating students. The results of the study showed that the Direct Instruction model is effective on the concept acquisition and maintenance in all the participants. Generalization data showed that the sphere concept was mastered by the participants. Social Validity data revealed that all students enjoyed the intervention. Results of the study were discussed and recommendations for further research were provided.

**Keywords:** Visual Impairment, Concept Acquisition, Direct Instruction Model.

Concepts play a significant role in reasoning, classifying, learning, memory, deduction, language comprehension and language production, explanation, inference, problem solving and generalization (Özmen-Güzel&Ünal, 2008; Thagard, 1992). Concepts are mental representations of objects, events, actions, qualities, or relationships and other item classifications; therefore, individuals often use concepts to communicate in their daily lives (Jonassen, 2006). Concept learning consists of generalization among different examples and discrimination between examples and nonexamples (Hayes & Conway, 2000; Park & Tennyson, 1986; Özmen-Güzel&Ünal, 2008). However, one of the major limitations of visual impairment is the concept range and variety (Hill & Blasch, 1980). A great number of students learn so many concepts through different activities. They observe, experience and understand the world with the help of these facilities (Markle, 1975). Concept development for an individual with visual impairment provides a good background for learning academic, social and psychomotor skills. Mobility oriented basic concepts such as body schema, body concept and body awareness including body image, body parts and figure, right-left side, directions, spatial and environmental concepts are critical for the individuals with visual impairment. Moreover, the acquisition of geometric shape concepts and measurement skills facilitates the examination of the environment. Therefore, knowledge of geometric shape concepts enables the visually impaired person to use objects as clues while moving around.

Geometry is both a learning area and a tool to comprehend and interpret the world we live in (National Council for Teachers of Maths, NCTM, 2000). Mastering in geometry assists individuals to generalize acquired concept knowledge, to think critically and to explain the information concretely (Battista, 2007; Clements, 1998). Additionally, some certain factors affect geometry learning process such as teaching method, teacher qualifications, student attitudes, student readiness, families, teachers and physical conditions (Messick & Reynolds, 1992). In this context, teaching programmes need improvement to avoid student failure (Sener & Belfiore, 2005). In the literature, there have been a number of studies related to Concept-Instruction (Gagne, 1965; Merrill and Tennyson, 1977; Bruner, 1961) and Direct Instruction model (Engelmann & Carnine, 1982). Direct Instruction model (Engelmann & Carnine, 1991) provides a presentation of concepts through concept instruction and schematic organizers. Kircaali-İftar, Birkan and Uysal (1998) compared the structured language to the natural language presentation on colours and shapes for the mentally impaired through Gagne model. The presentation with natural language was found more effective. Furthermore, Özmen-Güzel and Ünal (2008) compared the effectiveness of Gagne model to Merrill and Tennyson model in teaching the mentally impaired the concepts of square and triangle. According to the results, two students succeeded in Gagne model and two in both of the models. The purpose of this study is to present the effectiveness of Direct Instruction Model in acquisition and maintenance of geometric shape concepts for the visually impaired students.

Direct Instruction Model was developed for the teaching of cognitive skills. The Model has been defined as a teacher-centered instruction model which focuses on curriculum design for the success of the student and which includes generalizable teaching presentations, assessments and strategies as well as written teaching processes (Engelmann and Carnine, 1991; Tuncer and Altunay, 2004). Direct Instruction Model, theoretically based on the studies of Engelmann and Carnine (1981), emphasizes the principle that the changes on students can be assessed and evaluated when a planned instruction is systematically offered to the students. In the Model, the most important feature of the instruction skills is that they do not show variations from practice to practice and

according to the personal characteristics of teachers. In Direct Instruction Model, the role of the teacher in the learning process was specified and the instruction skills were practically defined. It is suggested that every child can learn when the elements of the teaching process offered to the student are well-controlled. The importance of the elements such as supporting the curriculum in learning-teaching activities, choosing the examples to be presented for the teaching process, observing the improvement of the student, and systematically correcting the mistakes of the student have been pointed out (Tuncer&Altunay, 2004).

In Direct Instruction Model, factors influencing the learning process can be categorized as designing the teaching curricula, selecting the examples to be presented, and their sequencing, monitoring student progress and correcting student mistakes. When teachers consider the principles of Direct Instruction model, they can easily observe the changes in student behaviours (Engelmann & Carnine, 1991; Tuncer&Altunay, 2004). Three different types of Direct Instruction Model exist; non-comparative sequences, comparative single-dimension sequences and nouns. Non-comparative sequences are concepts that cannot be explained without showing the concept examples or their synonyms (Altunay, 2008; Tuncer&Altunay, 2004). In a non-comparative sequence presentation, a case has been labelled; while in comparative sequence, change from one condition to another has been labelled. Both types of arrangement of examples in teaching are similar. In the positive-first sequences, two negative examples follow the three positive examples and assessment starts with the positive example with miscellaneous questions. In the negative-first sequences, three positive examples follow the two negative examples and assessment starts with the negative examples. Teaching of such a sequence has been completed according to a "continuous cycle" where changes between examples occur quickly. In the comparative sequence, a reference example is available for students to be able to compare with the first example. Error correction processes of both sequences are similar.

The geometric shapes used for instruction in this study belong to the noun category. Nouns are multi-dimensional concepts, defined as labels for object classes such as, trucks, numbers, letters and geometric shapes. Some nouns entail sub-categories called higher-order nouns. Hierarchically, examples of the higher order nouns are furniture, vegetables and clothes.

The arrangement in teaching nouns starts with three positive examples and assessment begins with two positive examples. If the student has already labelled a geometric shape, newly learnt concept has been questioned randomly. For instance, while teaching the concept "circle" to the student who has already known the concept "square", square and circle have been studied together. If the students are not able to label any geometric shape, the objects or pictures of the objects that have been previously labelled by them can be used. In noun presentations, negative examples cannot be labelled as "...not".

Several principles need to be considered in preparing the concept presentation. Engelmann and Carnine (1982) developed five principles for sequencing and ordering examples. (1) *The wording principle*: Presenting all the examples with the same statements. To make the sequence as clear as possible, same wording should be used on all items, (2) *The set-up principle*: Examples and non-examples selected for the initial teaching of concept should represent a great number of possible irrelevant features. It is suggested to use the same material for both material presentation and assessment. For example, while teaching the concept "on", only "order and box" can be used to focus on the changing position of the box (for relatedness). (3) *The difference principle*: In order to visualize the limits of a concept, we should demonstrate examples and non -examples that are similar to one another except in the critical feature and indicate that they are different. (4) *The sameness principle*: To show the range of variation of the concept, we should use the examples of the concept that differ from one another as much as possible. Yet, it still illustrates the concept and indicates that they are the same. (5) *The testing principle*: To test the acquisition, we had better present new, untaught examples and non- examples in a random order (Watkins & Slocum, 2004).

Concept teaching within the same concept group shows similarities (Kameenui& Simmons, 1990). For example, in the instruction of the concepts "cylinder" and "cat", since they belong to the same group, their instruction shows similarities. Presentations with a single set have the risk of generalisation. To eliminate, presentation with more sets and expanded teaching are necessary. Expanding teaching in Direct Instruction Model are divided into four: (a) manipulative tasks, (b) fooler games, (c) implied-conclusion tasks and (d) event-centered tasks.

A significant body of research demonstrated that Direct Instruction Model has been effective in teaching concepts. Granzin and Carnine (1977) investigated the effect of diversifying the examples in concept presentation on concept learning. Carnine (1980a) conducted a study with 65 children aged 4-6 to identify how negative examples in concept presentation affect concept learning. Results indicate that the group which received training with the set showing the least dissimilarity between the negative and positive examples for the negative examples, showed considerably higher numbers of accurate behaviours. Besides, Carnine (1980b) analysed the effects of varying the discrete features in concept presentation examples on the pace of concept acquisition. Gersten, White, Falco and Carnine (1982) examined the effects of differentiation while presenting the concepts statically or dynamically to children with or without disabilities in terms of concept acquisition rate. The results confirm that presenting the concepts through a continuous cycle to children with or without disability lead to

quicker acquisition of the concepts. Literature lacks studies on teaching geometric shape concepts considering the principles of the Direct Instruction Model to the students with visual impairment. This study will serve as an important source to investigate the effectiveness of the Direct Instruction model on geometric shape concept teaching and identifying instructional design variables that are effective on the concept learning of the visually impaired students.

## METHOD

### *Participants and Setting*

Three 1<sup>st</sup> grade primary public school students with visual impairment attending an urban public school participated in this study. The participants in this study had not attended Pre-Primary education. The students were also Braille-literate. Specifically, each student referred for this study; (a) was able to label two dimensional geometric shapes and cylinder as a three dimensional shape, (b) was able to speak four-or-five-word sentences, (c) was only visually impaired, (d) was able to label the sphere concept, (e) had not been exposed to Direct Instruction prior to this study, (f) was ranging in age from 7 to 8. The chronological ages of three participants are as follows: the first participant was 7 years old; the second participant was 7 years and 6 months old and the third participant was 8 years old. The third participant was a boy and the remaining participants were girls. The study was conducted in the reading room, under the guidance of the first researcher. In order to assess inter-observer agreement and treatment integrity, a video-camera was used to record all the sessions.

### *Experimental design*

As Kazdin (1978) have indicated, the rationale of single-subject designs is to compare the performance of the participants under different conditions. In this study, a multiple probe-across-participants design was used to demonstrate the effectiveness of Direct Instruction model in acquisition and maintenance of geometric shape concepts to students with visual impairment. In the multiple-probe design, prior to the intervention (independent variable) being introduced, probe data were collected for any case (behaviour, setting or participant). In the first case, baseline data were collected in sequential three sessions. When the baseline data show stability, the intervention (independent variable) was introduced to the first case (Tawney ve Gast, 1984). When the criteria were met or the baseline data showed stability in the first case, baseline data were collected for the second case. For other cases, probe data were also collected. This process continued until all the cases received the intervention (Güzel, 1998). Additionally, multiple-probe procedures suggest cost effective data collection time (Murphy & Bryan, 1980). The dependent variable of the study was the achievement level of meeting the goals of the sphere concept. Considering the principles of the Direct Instruction model, the independent variable was the teaching of the sphere concept. For each student, experimental procedures were applied for a week. The experimental process was conducted in two sessions per day. In order to collect data, criterion-reference tests were developed. The last objective attained by the participant was recorded on a graph during baseline and after the intervention and in the maintenance. Also maintenance data were collected to determine the effectiveness of the concept acquired by the participant.

*Baseline.* In order to collect the data, sphere-criterion referenced tests were conducted individually and participants' performance level for the sphere concept was determined in three sequential sessions. When the data of the intervention from the first participant showed stability, baseline data of the second participant were collected in three sequential sessions and accordingly, and probe data of the third participant were collected in a single session. When the intervention data of the second participant showed stability, baseline data of the third participant were collected in three sequential sessions.

*Intervention.* After collecting steady baseline data, the first participant was instructed about the sphere concept considering the principles of Direct Instruction model and the sphere concept was taught individually. Criterion-references test was applied at the end of each intervention session.











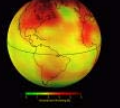

*Maintenance and generalization.* Maintenance data were collected at 15, 25 & 35 days post intervention. The Criterion-referenced test of the acquired concept was applied to determine the performance level of the participants. Generalization test data were collected once during baseline and once after intervention. During generalization, each student was asked to apply different geometric shape concepts into various situations.

### *Instructional procedures*

Prior to the instruction, instructional procedures of the sphere concept were designed considering the principles and sample order of Direct Instruction model. After presenting three positive nouns, assessment was given accordingly. During the presentation, the objects were shown and labelled by saying that "this is spherical". Assessment also started with two positive statements used in the presentation before. Considering the

assessment principles (the number of positive examples should outnumber that of negative, examples need to follow an unpredictable sequence). The concepts which the participants had already labelled and acquired recently were questioned randomly. The presentation and assessment lasted 5-6 minutes per student. Table 1 shows the presentation of the sphere concept including examples.

*Table 1.  
Table 1 Shows the Presentation of the Sphere Concept Including the Examples.*

<i>Examples</i>	<i>Presentation of the Teacher</i>
	<i>(1. positive example)</i> Spherical
	<i>(2. positive example )</i> Spherical
	<i>(3. positive example)</i> Spherical
	<b>Assessment</b> <i>(1. Assessment Question)(One of the examples used in the presentation before)</i> What shape is it?
	<i>(2. Assessment Question)(One of the examples used in the presentation before)</i> What shape is it?
	<i>(3. Assessment Question)</i> What shape is it?
	<i>(4. Assessment Question)</i> What shape is it?
	<i>(5. Assessment Question)</i> What shape is it?
	<i>(6. Assessment Question)</i> What shape is it?
	<i>(7. Assessment Question)</i> What shape is it?
	<i>(8. Assessment Question)</i> What shape is it?
	<i>(9. Assessment Question)</i> What shape is it?

### *Data collection*

In order to collect research data, criterion-referenced tests were designed including ten labelling questions and generalization questions. Criterion-reference tests were applied prior to the intervention to determine baseline for each participant. Extension questions were asked to determine whether students were able to generalise acquired knowledge to different situations. A Criterion-reference test was conducted in the maintenance phase. Maintenance data were collected at 15, 25 & 35 days post intervention to determine whether the participants maintained acquired knowledge. During the criterion-referenced test, the researcher gave a sphere shaped object to the participant and said, "Examine it". Physical assistance was provided when the student had difficulty with examining process. The researcher asked to the participant "Tell me its shape". All sessions were videotaped.

### *Scoring procedures and data analysis*

During the assessment with the Criterion-referenced test, 100% criterion principle was taken into consideration. When the participant responded all the ten questions in the test, it was accepted that the objective of the study was fulfilled. In this study, the performance of each participant was recorded in the phases of baseline, intervention and maintenance. Data were visualized in the graph.

### *Inter-observer agreement and treatment integrity*

Agreement was assessed through the use of a second observer independently observing 35% of the recorded sessions across baseline, intervention, and maintenance equally distributed across the three students. Percentage of agreement was calculated by dividing the number of agreements plus disagreements, then multiplying by 100 (Barlow & Hersen, 1984). Inter observer agreement ranged from 98%–100% ( $X = 99\%$ ), and for generalization ranged from 98%–100% ( $X = 99\%$ ). Procedural integrity was monitored by a second observer during 25% of the all sessions. Integrity was assessed for teacher's oral presentation, example sequencing and assessment principles. Procedural integrity was 100% across all session components.

### *Social validity*

Social validity is referred to ascertain practice of a socially favourable study and to detect its socially momentous effects (Foster & Mash, 1999; Wolf, 1978). An important measure of a study's success depends on its social acceptability or validity. Wolf (1978) suggests that assessing the goal significance, appropriateness of method and significance of consequences to identify the social validity of a practice is critical. As for social validity, a Likert-type questionnaire was developed and conducted on an individual basis. Results of the social validity questionnaires showed that all the students participated ( $n=3$ ) liked the intervention very much. Within education, a single-subject research was used to determine main characteristics of behavior (e.g., theory) and to report interventions (independent variables) that practically changed in socially significant results (dependent variables) (Wolf, 1978).

## **RESULTS**

Figure 1 shows the baseline, the intervention and the maintenance data for the three participants with visual impairment. The performance levels of three participants towards the geometric shape concept are graphed on Figure 1. As it was seen in the graph the first participant was unable to perform any objective. She could not label the sphere concept for three sessions. In the intervention sessions, sphere concept instruction was presented considering the principles of Direct Instruction model. The first participant labelled sphere concept with 100% performance level in the assessment at the end of the intervention. While the baseline data were collected for the first participant, the probe data of the second and the third participant were collected. When the intervention data of the first participant showed stability, baseline data of the second participant were collected in three sequential sessions and one more probe data of the third participant were collected. Second participant were not able to perform any objective. After the intervention, the assessment data showed that second participant labelled the sphere concept with a 100% performance level. When the intervention data of the second participant showed stability, baseline data of the third participant were collected in three sequential sessions. Third participant were not able to perform any objective. After the intervention, the assessment data showed that third participant labelled concept sphere with a 100% performance level. In order to determine whether the participants maintained acquired knowledge or not, maintenance data were collected at 15, 25 & 35 days post intervention. In the light of maintenance data, it can be easily stated that the participants were able to label concept shapes after a while. After the instructional process, extension activities were practised. Extension activities (generalization) are highly important for the permanence of the concepts. Figure 2 shows the performance levels of the participants in the generalization phase.



Figure 1

Figure 1 shows the baseline, intervention and maintenance data of the participants.

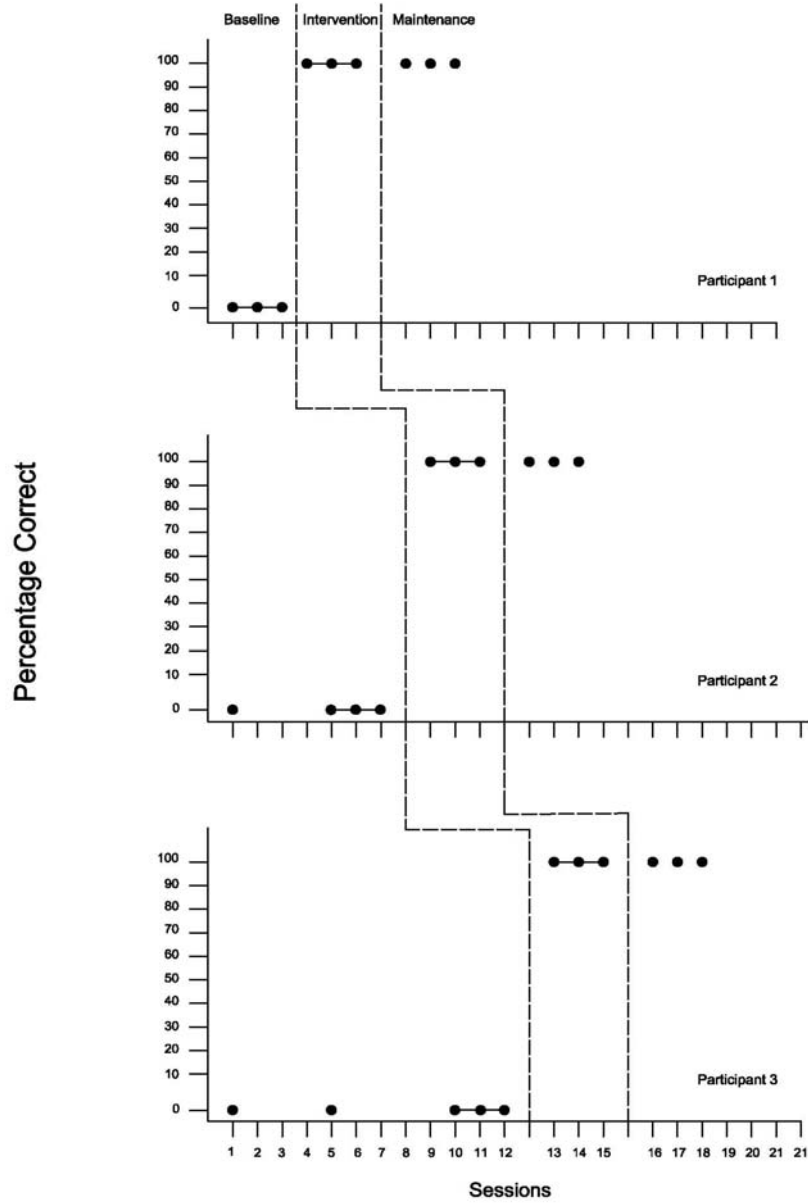
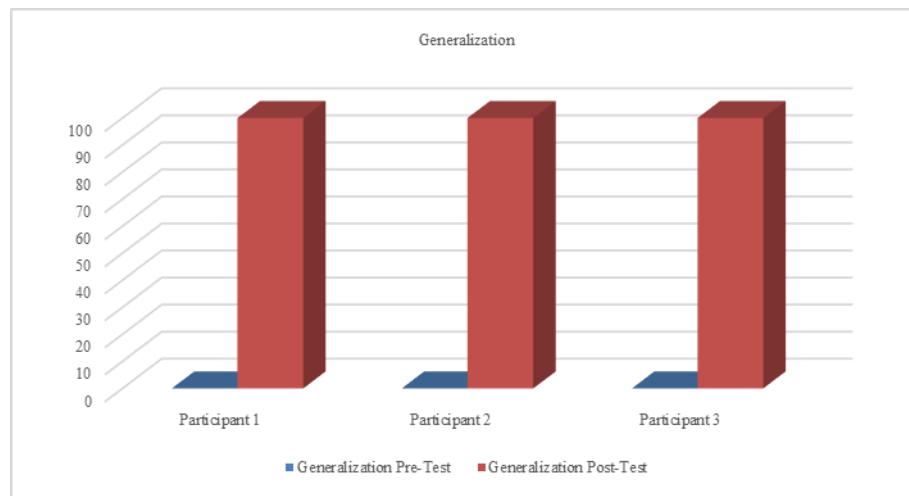


Figure 2

Figure 2 shows the generalization data of the participants.



## DISCUSSION

The purpose of the present study was to show the effectiveness of direct instruction model in acquisition and maintenance of geometric shape concepts to students with visual impairment. Results indicated that the Direct Instruction model was more effective than the traditional model in teaching concepts. Results also demonstrated that Direct Instruction model was highly effective with these students. In addition, the evidence from this study suggested that Direct Instruction model required less instruction time with all three participants. In this study real- life materials were used for labelling the sphere concept (ball). In a study by Fielding, Kameenui and Gersten (1983) stated that using authentic materials like a ‘ball’ in Direct Instruction model facilitates student success. This also supports the results of the current study. In general, the results indicated that the Direct Instruction model was effective on the sphere concept acquisition and maintenance for all students. Previous studies showed that students’ ability to focus on the attribution of examples and their overall attention increase when the language used in concept instructions is clear and straightforward (Engelmann & Carnine, 1991; Tuncer & Altunay, 2004; Özmen & Unal, 2008).

In Direct Instruction Model, the instructions are prepared based on the association types enhance the teaching practices of the teacher. The teacher knows how to withdraw the clues and how to present the examples. In the Model, the most important feature of the instruction skills is that they do not vary from practice to practice and according to the personal styles of teachers. In Direct Instruction Model, the role of the teacher in the learning process of the individual was defined and the instruction skills were exactly explained (Altunay, 2008). Furthermore, it is observed that the students are highly motivated and learn permanently as a result of the instructions which progress cumulatively. Also, it is highlighted that including the expanded teaching and worksheet items in Direct Instruction Model helps students to master their acquired knowledge. Therefore, the teachers need to know how to conduct the subject, how to review and evaluate, and how to apply the process of correcting mistakes in teaching.

In conclusion, evidence from this study supported the Direct Instruction model in teaching academic concepts to students with visual impairment. It is important to use evidence-based practices in education in order to result in effective outcomes from the curricula created for the education of the individuals with special needs. The interventions that positively affect the performance of the student need to be applied in classes. That is why it is critical to build a bridge between the teaching process in class and the research that suggests the efficiency of the practice (Carnine, 1997; Cook & Schirmer, 2006). Yet, evidence-based practices are the instruction techniques which fills the gap between research and practice.

In future research, the researchers have demonstrated the success of this model within a primary school setting for students with visual impairment. This study targeted only three students in a 1st grade classroom in Turkey, further research with different grade level, subject level, and countries programs are warranted to note generalized effects. Therefore, this study suggests that the effectiveness of Direct Instruction model in teaching different concepts should be compared with students from different age groups and different special needs, too. The above-mentioned results of the current study and the following constraints should prompt future research in other academic areas within the Turkish education system. But more importantly, this study provides a

systematic research model to evaluate research-based academic model in an applied setting. Instituting such an applied research model must be expanded within the Turkish public education system to further assist those students in need of academic support, both for qualifying for special education services and for general education services. To break the cycle of students' learning failure, the awareness in Turkey regarding the special education and specific learning disabilities should improve with the support of the governments' education programs (Sener& Belfiore, 2005). The result of such an applied research agenda for Turkish public education will only benefit allinvolved, promoting educational success for all students.

A primary purpose of the present study was to provide further evidence on the effectiveness of concept instruction considering the Direct Instruction model. The potential significance of such evidence for teacher educators lies mostly in the good options it might suggest for effective concept instruction. Concept Instruction considering the principles of the Direct Instructional model might as well require well-designed protocols. With the growing demand for accountability and the functional significance of assessing the effectiveness and generality of interventions, further studies related to the Direct Instruction model will be beneficial.

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## EFFECTS OF VIRTUAL LABORATORY ON ACHIEVEMENT LEVELS AND GENDER OF SECONDARY SCHOOL CHEMISTRY STUDENTS IN INDIVIDUALIZED AND COLLABORATIVE SETTINGS IN MINNA, NIGERIA

GAMBARI, Amosa Isiaka (Ph.D)  
Associate Professor (Educational Technology),  
Department of Educational Technology, Federal University of Technology, Minna  
**E-mail:** [gambari@futminna.edu.ng](mailto:gambari@futminna.edu.ng) & [gambarii@yahoo.com](mailto:gambarii@yahoo.com)  
**Phone No:** +234-803-689-7955; +234-805-558-6716

OBIELODAN, O. O. (Ph.D)  
Senior Lecturer (Educational Technology),  
Department of Educational Technology, Faculty of Education, University of Ilorin, Nigeria  
**E-mail:** [obielodan@yahoo.com](mailto:obielodan@yahoo.com)

KAWU, H.  
Lecturer I (Educational Technology),  
Department of Educational Technology, Federal University of Technology Minna  
**Email:** [h.kawu@futminna.edu.ng](mailto:h.kawu@futminna.edu.ng)

### ABSTRACT

The study investigated the effects of virtual laboratory on the achievement levels and gender of secondary school chemistry students in individualized and collaborative settings in Minna, Nigeria. Five hypotheses were formulated and tested at 0.05 level of significance. 120 Senior Secondary Class Two (SS II) chemistry Students were stratified along gender and achievement levels. Sixty students (male, n = 30 & female, n = 30) were randomly selected from each school. The study employed a quasi-experimental involving pretest, posttest, and control group design. A validated Chemistry Achievement Test (CAT) made-up of twenty multiple-choice items was used for data collection. A reliability coefficient of 0.91 was obtained from the pilot test using Kuder Richardson (KR-20). Mean and ANCOVA were employed in analyzing the data. The results showed that: (i) Students exposed to chemistry virtual laboratory package in collaborative learning setting outperformed their counterparts in individualized setting; (ii) there was significant difference in the mean achievement scores of male and female students taught using Chemistry using Virtual Laboratory in Individualized Setting; (iii) There was no significant difference in the mean achievement scores of male and female students taught chemistry using virtual laboratory in collaborative learning setting; (iv) there was no significant difference in the mean achievement scores of high, medium and low students taught using chemistry virtual laboratory in collaborative, and individualized settings respectively. Based on these findings, it was recommended that the use of virtual laboratory instruction in collaborative setting should be encouraged in teaching chemistry at senior secondary schools in Nigeria.

**Keyword:** Virtual Laboratory, Chemistry, Achievement Levels, Gender, Individualized Learning, Collaborative Learning

### INTRODUCTION

Science and technology play a vital role in the development of any nation. They are the predictors of success and development of any nation's economy. Chemistry occupies a central position among all science subjects. It is a core subject for Medical science, Textile science, Agriculture science, Synthetic industry, Printing technology, Pharmacy, Chemical technology (Jegede, 2007). Research evidences have proved that chemistry's contribution to quality of life and nation building is enormous in all aspects of human endeavour (Olorukooba, 2007; Olorundare, 2011). Probably that is why the developed nations recognized the relevance of chemistry in their national economy. It was based on this fact that the Federal Republic of Nigeria through her National Policy on Education made chemistry a compulsory science subject at secondary school level (FRN, 2013). Reiterating the importance of chemistry, Ezenwa (2005) opined that no nation can be scientifically and technologically developed without adequate level of chemistry education.

In spite of the importance of chemistry as a requirement for many specialized science and technology courses at the universities, polytechnics and colleges of education, there has not been remarkable improvements in the students' performance in the subjects at senior secondary school level in Nigeria (NECO, 2015; WAEC, 2015). The chief examiners' reported that the percentage of students that passed chemistry at credit level and above (A1-C6) was consistently less than 50% for the past five years (WAEC, 2015) in Nigeria. Students' poor

performance in chemistry was noted in the NECO and WAEC Chief Examiners' Reports. This poor performance in chemistry is very disturbing and if not checked, may jeopardize the placement chances of students in tertiary institutions, not only in chemistry education but also in other chemistry related disciplines. This has serious implications for Nigeria economy, security, and manpower development.

Consequently, efforts have continuously been made to improve on chemistry teaching and learning especially at the senior secondary level so as to ensure a sound foundation for future studies. Researchers such as Adesoji and Fisuyi (2001), Evans and Leinhardt (2008), Olorukooba (2007), Olorundare (2014) and many others have identified class size, poor student background in science, teacher' exposure, poor instructional methods, negative attitude of teachers, in adequate / lack of laboratory facilities as factors contributing to students' poor performance in chemistry.

Students' failure rate in chemistry has been traced to lack of facilities for chemistry practical in schools. In fact, Njoku (2007), Okebukola (1999) and Olorundare (2014) lamented that students' failure in Chemistry at Secondary School Certificate Examination (SSCE) can be traced to their poor performance in the practical which can frequently attributed to the lack of laboratory practice (Yang & Heh, 2007). Few students with good performance do so by rote memorization of facts without transforming the language and materials teachers use in Chemistry practical into meaningful representations.

Previous studies have reported that chemistry practical cannot be properly embedded into traditional chemistry courses for various reasons, such as: safety concerns, lack of self-confidence, an excessive amount of time and effort required to conduct accurate experiments and many others (Okebukola, 2006; Njoku, 2007; Obrentz, 2012). Nonetheless, it is possible to overcome these obstacles via technology-base alternatives (Okon, Kaliszan, Lawenda, Stoklosa, Rajtar, Meyer, & Stroinski, 2006).

An alternative learning environment, called a virtual laboratory, can help to make this crucial educational application available to students (Kumar, Pakala, Ragade, & Wong, 1998; Shin, Yoon, Park & Lee, 2000; Grob, 2002; SAVVIS, 2010; Jeschke, Richter, & Zorn, 2010). Virtual laboratory is a learning environment in which students convert their theoretical knowledge into practical knowledge by conducting experiments (Woodfield, 2005). Virtual laboratories simulate a real laboratory environment and processes. They provide students with meaningful virtual experiences and present important concepts, principles, and processes. By means of virtual laboratories, students have the opportunity of repeating any incorrect experiment or to deepen the intended experiences. Moreover, the interactive nature of such teaching methods offers a clear and enjoyable learning environment (Ardac & Akaygun, 2004, Jeschke, Richter, & Zorn, 2010).

A virtual laboratory may sometimes be a preferable alternative, or simply a supportive learning environment, to real laboratories. It provides students with opportunities such as enriching their learning experiences; conducting experiments as if they were in real laboratories; and improving their experiment related skills such as manipulating materials and equipment, collecting data, completing experiment process in an interactive way (with boundless supplies), and preparing experiment reports (Subramanian & Marsic, 2001). Researchers have determined that instructions carried out with virtual laboratories significantly increase student achievement levels (Dalgarno, Bishop, Adlong, & Bedgood, 2009; Yu, Brown, & Billet, 2005 & Tatli, & Ayas, 2013). Virtual environments let students observe the process in more detail, compared to board and chalk activities of the traditional classroom or partially completed experiments of the real laboratory environment. In addition, virtual environments foster attention and motivation towards the course by supporting a discussion platform among partners, peers, and among students and teacher (Dobson, 2009; Lawrence, 2011).

Furthermore, some researchers even argue that performing experiments within a virtual environment is more effective than performing experiments in real laboratories (Gambari, Fagbemi, Falode & Idris, 2014; Pyatt & Sims, 2012; Swan & O'Donnell, 2009; Tatli & Ayas, 2012; Bayrak, Kanlı & KandilIngeç, 2007). Studies showed that, in traditional learning environments, there are always inconsistencies between student predictions and observations (Kerr, Rynearson, & Kerr, 2004; Josephsen & Kristensen, 2006). Such environments also make students reserved and cause them to refrain from expressing their opinions directly (Sheppard, 2006). In contrast, virtual learning environments enable learners to repeat the events several times without hesitation, to zoom in and out, and to watch in slow motion being questioned in any way (Tuyuz, 2010). Virtual laboratory is applicable to individualized or collaborative learning environments.

Individualized Instructional Strategy (IIS) is a teaching strategy in which an individual student works alone based on his/her ability using a variety of instructional activities to improve his/her understanding of chemistry. This strategy requires each individual to present his/her solution to the chemistry problem without the

cooperation or assistance of other classmates (Aluko & Olorundare, 2011). McAllister and Mitchell (2002) reported that students taught using computer for individualizing learning usually have poor interaction with their peer therefore, there is need for collaborative learning.

In the submission of Vasiliou and Economides (2007), collaborative learning is a student-centered, task-based, activity-based learning approach that provides several advantages to the student. It can assist the students to enhance the skills of communication, interpersonal social relationship, cooperation of sharing and caring, openness, flexibility, adaptability, knowledge retention, higher-order of critical thinking, creativity, management, practicality, responsibility, trustworthiness of dependability, involvement, engagement of participation, commitment of persistency, motivation, confidence and self-efficacy. Meanwhile, it is an educational method in which students work together in small groups towards a common goal (Dillenbourg, Baker, Blaye & O'Malley, 1996; Hafner & Ellis, 2004). The teacher acts as a coach, mentor or facilitator of the learning process. The successful achievement of the common goal is shared among all group members.

Students, through virtual laboratory platform, can work together on a task, exchange their views, experiences, opinions, discuss and negotiate strategies, actions and results (Vasiliou & Economides, 2007). These actions can provide students with opportunity to assist, explain, teach, understand, review and influence each other. By developing a learning community, it could also provide the opportunity to combine the special abilities of everyone to achieve a common goal in a collaborative means. The teacher acts as a coach, mentor or facilitator of the learning process. The successful achievement of the common goal is shared among all group members.

In a training workshop organized in the Center for Advancing Teaching and Learning in 2010 at the University of Wisconsin, five major collaborative learning techniques were identified: Think-Pair-Share (TPS), Reciprocal Teaching (RT), Think-Aloud Pair Problem Solving (TAPPS), Group Grid (GG) and Group Writing Assignments (GWA). Each of the identified collaborative group aforementioned has their dynamics and extent of collaboration mode (Cerbin, 2010). In this study Reciprocal Teaching method of collaborative instructional strategy was explored. Reciprocal Teaching is also called Reciprocal Peer Tutoring (RPT). Reciprocal Peer Tutoring collaborative strategy is a procedure in which small groups work together on learning tasks (Dufrene, Noell, Gilbertson & Duhon 2005). In this type of collaborative learning, students function reciprocally as both tutor and tutee (Ogbuanya, Bakare & Igweh, 2009; Obiunu, 2008). This dual role is beneficial because it enables students to gain from both the preparation and the instruction in which tutors engage and from the instructions that tutees receive (Obiunu, 2008, Oludipe, 2007). RPT helps teachers to cope with challenges such as limited instructional time, multiple curricular requirement and appropriate social engagement among learners (Ogbuanya et al, 2009).

The effectiveness of RPT in the teaching and learning process has largely been documented. Studies have shown that RPT increased students' academic achievement, engagement, and reduce time spent on learning (Egbockuku and Obiunu, 2006; Oludipe, 2007, Ogbuanya, Bakare & Igweh, 2009). Oludipe (2007) and Egbujuo (2012) reported significant improvement in achievement of students in physics and chemistry respectively after they were exposed to RPT. In another study by Ogbuanya et al (2009), there was a significant effect on students' achievement in electronics technology after the students were also exposed to Reciprocal Peer Tutoring. Similarly, Slavin, (1993), Magolda and Rogers (1987) have shown that RPT is an effective technique for increasing students' academic achievement irrespective of their ability levels.

Students' ability level is one of the factors that responsible for differential learning outcome and it has attracted the attention of educational researchers. In Nigeria classroom, it is common to find students of mixed academic ability levels lumped together without considering their individual differences (Gambari, James & Olumorin, 2013). The capacity of students to engage themselves in any educational task which requires higher cognitive functioning depends on factors which include their academic potentiality. This could be tagged ability or level of academic attainment. Students are not the same especially when we find out the rate at which facts and principles in sciences are being assimilated. This is to say that, there is disparity in the ability to perform specific tasks (Adesoji, 2008). Several studies have shown that learners are qualitatively different in their ability levels and in learning problems. For instance, Aluko (2004), Fajola (2000), Ige (2004), Gambari, Olumorin and Yusuf (2013), Gambari and Yusuf (2014) found that high ability learners are more intelligent than the low or medium ability learners in solving task in science courses.

Yusuf (2004) identified three ability levels in relation to teaching-learning situation viz: High, medium and low. High ability level learners are those that prefer isolation and social distance, theoretical and abstract ideas (akin to field independent learners). According to him, high ability individuals are better than medium or low ability group might be better in other tasks that have to do with the use of hands. In this case, the high ability group has

greater ability to structure information and solve problems. However, medium ability level learners perform relatively better on learning activities involving social materials, and are more likely to require external defined goals and reinforcements (Yusuf, 1997; Abakpa & Iji, 2011). Based on this classification, students can be grouped based on their ability levels. Many of the previous studies did not consider the effects of ability grouping on gender.

Gender differences have historically been held responsible for divergence in academia and career success. Many argue that females are more likely to have better verbal abilities than males and conversely, males are more likely to have better mathematical skills than females (Skaalvik & Skaalvik, 2004). Researchers contend that soon after children enter elementary school, females begin to fall behind males on standardized assessment (Leahey & Guo, 2001). Freeman (2004), Meece, Glienke, and Burg (2006) and Weinburgh, (2000) reported that female students enrolled in more advanced high school science courses than males. Males always outperform females in elementary, middle and high school in science achievement (Gender Differences in Science, 2009; National Center for Education Statistics, 2009). In 2007, scores from the American College Test (ACT) indicated that females were less prepared for college science courses (Gender Differences in Science, 2009). The West African Examination Council results in Chemistry for the last five years indicate that good performance was by male students (WAEC, 2015). A study done by Sempala (2005) in USA, showed that gender inequities were most evident in laboratory assignment, consistent with Tobin's (1990) observation that females are less likely to be involved in operating laboratory equipment. This discrepancy between male and female science achievements continues in postsecondary education where women are less likely to major in science disciplines (Britner, 2008; Freeman, 2004; Gender Differences in Science, 2009; Miyake Kost-Smith, Finkelstein, Pollock, Cohen, & Ito, 2010). Previous achievement, gender stereotypes and interest in the discipline may all affect how females approach studying science as well as motivation to pursue degrees or careers in the field.

The urgent need for Nigeria to shift steadily and progressively from the traditional time tested methods and techniques of instructions as expository, teacher-centred demonstration, and laboratory exercises to demonstrate, visualize or verify known information to those based on Information Communication Technology (ICT) requires a fundamental shift of focus from the teacher to the learner as the centre of education, and a progressive adoption of new method of virtual laboratory. Unfortunately, Nigeria is yet to embrace the concept fully and adopt ICT based methods in teaching, especially at the primary and secondary school levels. Hence, there is paucity of study reports on the effects of virtual laboratory on the achievement of secondary school students' in practical chemistry in individualized and collaborative setting in Minna, Nigeria.

In Nigeria, the Chemistry curricula is structured such that significant amount of time is set aside for practical demonstration. West African Examination Council (WAEC) Chief Examiners Reports 2012 and 2013 revealed among other things that candidates' performance was not encouraging. According to the reports students were unable to make logical inferences from experimental results and attributed the poor performance especially in practical aspect of Chemistry to their non-familiarity with the use of simple laboratory equipment.

Students need practical experiences to enable them understand some abstracts concepts in chemistry, therefore, effective use of laboratory equipment and facilities can improve the mastery of chemistry concepts. However, most of the public secondary schools in Nigeria are faced with insufficient laboratory and equipment which limits the teachers to perform just simple laboratory activity (Adejoh & Ityokyaa, 2009). Physical experiments are rarely performed in some public secondary schools in Nigeria due to lack of equipment, facilities and other logistic problems (Akinleye, 1987; Gambari, et al 2012). In addition, the costs of carrying out experiments, arranging the equipment for laboratory activities are very laborious and time consuming. Checking students' performance during the laboratory activities can be tasking especially when dealing with large class (Tuyuz, 2010). When taking all these challenges into consideration, looking for appropriate alternatives is necessary, hence, the use of virtual laboratory in supporting the traditional laboratory method or its adoption in the absence of physical laboratory is inevitable.

Research reports have shown that computer technology has been associated with improvement of performance in education (Hart, 2006; Asan, 2003). Virtual learning is one of such new techniques, Literatures on the use of virtual laboratories demonstration in science courses are scarce in Nigeria however, few research literatures reported that students exposed to virtual laboratory perform better than the traditional laboratory demonstration (Gambari, Falode, Fagbemi & Idris, 2013; Lawrence, 2011; Dobson, 2009; Swan & O'Donnell, 2009). However, Stuckey-Mickell and Stuckey-Danner (2007) reported that students considered the face-to-face laboratory courses to be more effective than virtual laboratory simulation. Kerr, Rynearson, and Kerr (2004) compared achievement among students instructed using hands-on Chemistry labs versus those instructed using virtual Chemistry laboratory (eLabs). They found out that there were no significant differences in achievement gain



scores for the traditional versus the Virtual simulation. On the other hand, Svec and Anderson (1995) reported that computer simulation experiments are more effective than physical laboratory demonstration. Literatures on the findings of practical simulation of laboratory experiment have not been consistent.

From the literatures reviewed so far much has not been done on the use of virtual laboratory in Chemistry especially at senior secondary school level in Nigeria. Also, comparative studies on the effects of virtual laboratory in individualized and collaborative settings are very scanty. Furthermore, findings on the influence of gender and ability levels on students' achievements have not being conclusive. Therefore, there is need to carry out a study on the effects of virtual laboratory in individualized and collaborative setting considering other related variables.

### Research Hypotheses

The following hypotheses are formulated and tested at 0.05 level of significance:

- (i) There is no significant difference in the mean achievement scores of chemistry students taught using virtual laboratory in individualized and collaborative settings.
- (ii) There is no significant difference in the mean achievement scores of male and female chemistry students taught using virtual laboratory in individualized Setting.
- (iii) There is no significant difference in the mean achievement scores of male and female chemistry students taught using virtual laboratory in collaborative setting.
- (iv) There is no significant difference in the mean achievement scores of high, medium and low chemistry students taught using virtual laboratory in individualized setting.
- (v) There is no significant difference in the mean achievement scores of high, medium and low ability chemistry students taught using virtual laboratory in collaborative setting.

### METHODOLOGY

#### Research Design

The research design adopted for this study is a quasi-experimental which involves the pretest, posttest experimental and control group design. This design was adopted because the two groups involved have a common variable (achievement and gender). Tuckman (1978) and Karlinger (1974) advocated the use of this design in a situation where two or more groups possess the same variables. In this study, two levels of independent primary variable (two treatments), three levels of academic ability (high, medium and low) and two levels of gender (male and female). Both the experimental and control groups were given the pretest and posttest. Experimental Group was subjected to treatment using virtual laboratory package in collaborative setting while the Control Group was also subjected to virtual laboratory package in individualized setting. The design layout is as shown in the Table 1.

**Table 1: Research Design Layout**

<i>Groups</i>	<i>Pre-test</i>	<i>Treatment</i>	<i>Post-test</i>
Experimental Group	O <sub>1</sub>	Collaborative virtual laboratory	O <sub>2</sub>
Control Group	O <sub>3</sub>	Individualized Virtual Laboratory	O <sub>4</sub>

The independent variables in this study are the virtual laboratory in collaborative and individualized settings while the dependent variable is the achievement scores. Gender and ability levels are the moderating variables.

#### Sample and Sampling Techniques

The population of this study is the entire senior secondary school chemistry students in public schools within Minna Nigeria. Based on the nature of this research, a three-stage sampling technique was employed. First, a purposive sampling technique was employed to obtain two secondary schools in Minna, Nigeria. These schools were purposively sampled based on certain criteria: equivalence (chemistry laboratories, facilities and teachers), school type (public schools), gender composition (mixed schools), ICT equipment (computer laboratories under the School Net programme) and exposure (students and teachers' exposure to the use of computer in their schools).

Secondly, the selected two equivalent mixed schools were randomly assigned to the experimental and control group using simple random sampling technique. Finally, stratified sampling technique was used to select sample size for this study. The arranged list of element in the school into different strata based on gender (male & female) and ability level (high, medium & low), then, the required number was selected from each stratum. In order to achieve a higher degree of precision, the researcher based the selection on proportions. For instance, the

number selected from each stratum was on the basis of the proportion of the students in all the strata. After this, the researcher applied the simple random technique to select the people from the list in each stratum.

Students were grouped into ability levels (high, medium and low) based on their performance in the last promotion examinations in chemistry. The high level students were those whose average score fall within upper quartile (25%) which is (75-100%), medium level students were those whose mean score fall within medium quartile of 50% which is (50 - 74%) while low achievers are students whose mean score in the chemistry test fall within the bottom quartile of 25% which is (0-25%).

Two co-educational schools were selected for this study. A school was assigned to control group, while the other was assigned to collaborative learning group. Sixty students were assigned to virtual laboratory individualized learning strategy group. The experimental group (virtual laboratory collaborative learning) was assigned to gender and ability levels. Similarly, three students of the same ability level formed a group (i.e. high or medium or low only).

Grouping was achieved as follows: Ten students who scored highest in the last chemistry examination in the SSII were selected (they were stratified along gender) as high achieving students, and among the ten who scored lowest were selected as low achieving students. Ten among those who scored above average were selected as average achievers. In each collaborative learning class, for instance, there are three high-achieving, three average-achieving, and three low-achieving teams. The selection considered equal number of male and female students based on ability levels. These groups remained in place until the end of the treatment. The teams were formed immediately after the pretest. All students were exposed to the same treatment for the period of four weeks.

**Table 2: Distribution of Sample for the Study**

Groups	Gender		Achievement Levels		
	Male	Female	High	Medium	Low
Individualized	30	30	20	20	20
Homogeneous	15	15	10	10	10
Heterogeneous	15	15	10	10	10

From Table 2, the three groups comprised a total of 120 students, 30 students were exposed to reciprocal Peer Tutoring collaborative learning in collaborating settings (Experimental Group), another 30 students were exposed to Peer Tutoring collaborative learning setting, while 60 students were exposed to individualized virtual laboratory setting which was the control group.

#### **Validation of Research Instrument**

(i) Treatment: The validation of the research instrument (virtual laboratory package) took place in two phases: (a) experts validation by computer laboratory programmers and educational technology experts; (b) content validation by chemistry teachers.

**Experts' Validation:** The developed virtual laboratory package was given to two computer programmers to determine the appropriateness of the package in terms of language, typography, legibility, navigation, interface, animations, functionality, packaging, and durability. Similarly, two Educational Technology experts were requested to validate the package in terms of its suitability for instruction, simplicity, unity among illustrations, emphasis on key concepts, colour use, and text. Their suggestions and recommendations were used to modify the package.

**Content Validation:** Two secondary school teachers who are qualified and are currently teaching chemistry were requested to validate the experiments and the procedures for their learning which is contained in the treatment. They helped to ensure that all the contents and learning items are derived from the subject's curriculum and suitable for SSII chemistry students.

(ii) **Chemistry Achievement Test Validation:** CAT was given to two senior lecturers in Chemistry Department, Federal University of Technology, Minna, two chemistry teachers from secondary schools and two measurement and evaluation experts. These experts assess the face and content validity of the instrument in relation to the background of chemistry for secondary school students in SS two. Also, they examined all the items in the test instrument with reference to the: appropriateness of the content, and the extent to which the contents cover the topics they are meant to cover.

### Reliability of the Instrument

To test the reliability of Chemistry Achievement Test (CAT), it was pilot tested in one selected senior secondary schools in Minna, Nigeria. The samples from these schools were part of the research population, but were not selected for the real studies. The test instrument (CAT) was administered once on 25 selected students. The results obtained from this administration were subjected to Kuder Richardson's formula 20 (KR-20). The results showed that CAT had a reliability coefficient of 0.91. On the basis of the high index, the instrument was considered reliable and suitable in conducting the research.

### Method of Data Collection

The researcher along with trained research assistants examined the facilities in the selected schools. They also examined the facilities to determine their suitability for the study and seek for official permission and cooperation of the school management to use the schools. The cooperation of the students and staff in the selected schools were sought; they were adequately informed about the objectives of the study. Chemistry teachers in these schools were trained as research assistants. The entire study covered a period of four (4) weeks.

During the first week, a pretest was administered to the control and experimental groups using Chemistry Achievement Test. In the second week, the lesson was taught to the experimental group using virtual chemistry lab package in collaborative setting, while the control group was taught using virtual chemistry lab package in individualized setting after which the questions that were used for the pretest was reshuffled and administered to the students in the various groups as posttest. The actual teaching last for four weeks. The control and experimental group had two periods of 40 minutes each in a week with each class. The two secondary schools constitute one experimental group and a control group. The experimental group was exposed to the use of virtual chemistry lab in a collaborative setting while the control group was exposed to the use of virtual chemistry lab in an individualized setting.

### Experimental Procedures

**Control Group:** Individualized Virtual Laboratory Instruction (IVLI) method was used here. The students were taught the concepts by using virtual laboratory package only. Students proceeded with the chemistry practical and study at their own rate. Sets of questions were given to the students after each sequence of instruction and students provided answers to the questions without any teacher's or peer's interactions. The teacher's role was to monitor the activities of the students so as to ensure strict compliance with instructions of non-interaction among members.

**Experimental Group:** The learning activity involves students teaching one another in a group of three-member. Students jointly read a text or work on a task. Students take turns being the teacher for a segment of the text or task. In their teaching role, students lead the discussion, summarize material, ask questions, and clarify material. In this study, Virtual Laboratory package was used with Reciprocal Peer Tutoring strategy in a collaborative learning. Reciprocal Peer Tutoring involves the following four phases:

- (i) Instructor prepares students by showing how to perform the experiment in the video section of Virtual Laboratory Package
- (ii) In a group, students jointly study the course material presented via Virtual Laboratory
- (iii) Students take turns being the teacher and leading discussion of a segment of the demonstration
- (iv) Students summarized the segment, asks a question, and clarifies material

The forth week was used for posttest which was administered to the control and experimental groups. The test was distributed with the help of two teachers from each school. Thirty minutes was given to write the test. The scores from the test given to the experimental and control groups was recorded and subjected to data analysis.

## RESULTS

The data obtained from each group using Chemistry Achievement Test (CAT) were analyzed using Analysis of Covariance (ANCOVA) statistics. Four hypotheses were tested using ANCOVA. One of the reasons of the choice of ANCOVA for testing the research hypotheses was based on its ability to control for the effect of pre-test. All hypotheses were tested at 0.05 level of significance. Descriptive statistics was also used to give a simpler interpretation of the data and was further supported by graphical illustration. The results are presented in the tables based on the hypotheses.

**Hypothesis One:** There is no significant difference in the mean achievement scores of chemistry students taught using virtual laboratory in individualized and collaborative settings.

**Table 1a: ANCOVA of posttest scores of individualized and collaborative settings using pretest as covariate**

Source of Variation	Sum of Square	df	Mean Square	F	Significance (P)
Covariate (Pretest)	44.071	1	44.071	0.905	0.343
Main Effect (Treatment)	15286.055	1	15286.055	314.014	0.000*
Model	15799.279	2	7899.640	162.278	0.000
Residual	5695.512	117	48.680		
Total	487125.000	120			

\*Significant at 0.05 level.

Table 1a shows the ANCOVA comparison of posttest achievement scores of individualized and collaborative settings. An examination of Table 4.1a shows that  $F(1,120) = 314.014$ ,  $p = 0.000$ , the results of the analysis indicates that the main effect (treatment) was significant. On the basis of this, the hypothesis one was rejected. The results revealed that the strategies of instruction produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. The result indicates that the treatment, using individualized and collaborative settings accounted for the difference in the posttest achievement scores of the students. This implies that a statistical significant difference exists between the two groups of individualized and collaborative settings. To further show the improvement in learning after treatment, the mean gain scores between the pretest and posttest mean achievement scores of the two groups (individualized and collaborative settings) as shown in Table 1b and Figure 1.

**Table 1b: Mean gain scores of students taught chemistry using virtual laboratory in individualized and collaborative settings**

Group	Pretest	Posttest	Mean Gain Score
Individualized Setting	20.66	50.83	30.17
Collaborative Setting	24.00	73.75	49.75

From Table 1b, it was observed that the two groups had improvement as observed in their posttest. For instance, collaborative setting had highest mean gain scores 49.75 while Individualized setting had mean gain scores of 30.17. This shows that both groups benefited from the treatment.

**Hypothesis Two:** There is no significant difference in the mean achievement scores of male and female chemistry students taught using virtual laboratory in individualized setting.

**Table 2a: ANCOVA of achievements of male and female students taught chemistry virtual laboratory in individualized setting**

Source of Variation	Sum of Square	df	Mean Square	F	Significance (P)
Covariate (Pretest)	7.407	1	7.407	0.247	0.621
Main Effect (Gender)	145.927	1	145.927	4.862	0.032*
Model	147.609	2	73.804	2.459	0.095
Residual	1710.725	57	30.013		
Total	156900.000	60			

\*Significant at 0.05 level.

Table 2a shows the result of the hypothesis two. The hypothesis was tested using the pretest mean achievement scores of male and female as covariate for the analysis of Covariance. The F value of 4.862 was significant at 0.05 alpha level when  $F(1, 60) = 4.862, p < 0.05$ . The result shows that there was significant difference in the mean achievement scores of male and female students taught using virtual laboratory in individualized setting. On this basis, hypothesis two is therefore rejected. This shows that male students' achievement differed significantly from that of female students when both were taught with virtual laboratory. The mean gain scores between the pretest and posttest of male and female students using virtual laboratory in individualized setting was analyzed as shown in Table 2b.

**Table 2b: Mean gain scores of male and female students taught chemistry using virtual laboratory in individualized setting**

Group	Pretest	Posttest	Mean Gain Score
Male	21.37	52.41	31.04
Female	20.00	49.35	29.35

From Table 2b, male and female achievement was improved after posttest. For instance, Male students had highest mean gain scores of 31.04 while female students had mean gain scores of 29.35. This shows that both groups benefited from the treatment.

**Hypothesis Three:** There is no significant difference in the mean achievement scores of male and female chemistry students taught using virtual laboratory in collaborative setting.

**Table 3a: ANCOVA of achievement of male and female students taught chemistry virtual laboratory in collaborative setting**

Source of Variation	Sum of Square	df	Mean Square	F	Significance (P)
Covariate (Pretest)	52.173	1	52.173	0.777	0.382
Main Effect (Gender)	3.188	1	3.188	0.048	0.828 <sup>ns</sup>
Model	55.923	2	27.961	0.417	0.661
Residual	3825.327	57	67.111		
Total	330225.000	60			

ns: Not Significance at 0.05

Table 3a reveals the result of the hypothesis three. The hypothesis was tested using the pretest mean achievement scores of male and female as covariate for the analysis of Covariance. The  $F(1, 60) = 0.048$ , was not significant when  $p = 0.828 (p > 0.05)$ . This shows that there was no significant difference in the mean achievement scores of male and female students taught using virtual laboratory in collaborative setting. On this basis, hypothesis three is therefore not rejected. This implies that male students' achievement did not significantly differ from that of female students when both were taught with virtual laboratory. The mean gain scores between the pretest and posttest between male and female students using virtual laboratory in collaborative setting was analyzed as shown in Table 3b.

**Table 3b: Mean gain scores of male and female students taught chemistry using virtual laboratory in collaborative setting**

Group	Pretest	Posttest	Mean Gain Score
Male	24.17	75.50	51.33
Female	23.83	74.00	50.17

Table 3b shows that male and female students' achievement was improved after posttest. Male students had mean gain scores of 51.33 while female students had mean gain scores of 50.17. This shows that both groups benefited from the treatment.

**Hypothesis Four:** There is no significant difference in the mean achievement scores of high, medium and low chemistry students taught using virtual laboratory in individualized setting.

To find out whether any statistical significant difference exist in the posttest mean scores of high, medium and low level students taught with chemistry virtual laboratory using analysis of covariance (ANCOVA), is shown in Table 4a.

**Table 4a: ANCOVA of mean achievement scores of high, medium and low level students taught chemistry virtual laboratory in individualized setting**

Source of Variation	Sum of Square	df	Mean Square	F	Significance (P)
Covariate (Pretest)	34.123	1	34.123	1.113	0.296
Main Effect (Levels)	139.283	2	69.642	2.271	0.113 <sup>ns</sup>
Model	140.965	3	46.988	1.532	0.216
Residual	17.368	56	30.667		
Total	156900.000	60			

ns: Not Significance at 0.05

Table 4a presents the result of the analysis of covariance using the pretest scores of students in the three achievement levels as covariates. The result shows that F - value of 2.271 for the main effect was significant at 0.05 alpha level i.e.  $F(2, 60) = 2.271, p > 0.05$ . This implies that there is no statistical significant difference in the mean achievement scores of the high, medium and low level students. On this basis, hypothesis four was not rejected. Therefore, there is no significant difference in the performance of high, medium and low level students taught using chemistry virtual laboratory. To further show the improvement in learning after treatment, the mean gain scores between the pretest and posttest mean achievement scores of the three groups (low, medium and high) are shown in Table 4b.

**Table 4b: Mean gain scores of high, medium and low students taught chemistry using virtual laboratory in individualized setting**

Group	Pretest	Posttest	Mean Gain Score
High	13.68	50.53	36.85
Medium	20.27	52.78	32.51
Low	26.73	49.57	22.84

Table 4b reveals that all the three groups had improvement as after posttest. For instance, high level students had mean gain scores 36.85; followed by medium students with the mean gain scores of 32.51, while the low level students had the least mean gain scores of 22.84. This shows that all the groups benefited from the chemistry virtual laboratory using individualized setting.

**Hypothesis Five:** There is no significant difference in the mean achievement scores of high, medium and low ability chemistry students taught using virtual laboratory in collaborative setting.

To find out whether any statistical significant difference exist in the mean achievement scores of high, medium and low ability level students taught with chemistry virtual laboratory, the analysis of covariance (ANCOVA) was used.

**Table 5a: ANCOVA of mean achievement scores of high, medium and low ability level students taught chemistry virtual laboratory in collaborative setting**

Source of Variation	Sum of Square	df	Mean Square	F	Significance (P)
Covariate (Pretest)	22.645	1	22.645	0.339	0.563
Main Effect (Levels)	84.494	2	42.247	0.632	0.535 <sup>ns</sup>
Model	137.228	3	45.743	0.684	0.565
Residual	3744.022	56	66.858		
Total	330225.000	60			

ns: Not Significance at 0.05

Table 5a shows the result of the analysis of covariance using the pretest scores of students in the three achievement levels as covariates. The result shows that F- value of 0.632 for the main effect was not significant at 0.05 alpha level ( $F(2, 60) = 0.632, p > 0.05$ ). This means that there is no statistical significant difference in the mean achievement scores of the high, medium and low level students. On this basis, hypothesis five was not rejected. Therefore, there is no significant difference in the mean achievement scores of high, medium and low level students taught using chemistry virtual laboratory. To further show the improvement in learning after the treatment, the mean gain scores between the pretest and posttest mean achievement scores of the three groups (high, medium and low) are as shown in Table 5b.

**Table 5b: Mean gain scores of mean achievement scores of high, medium and low level students taught chemistry virtual laboratory in collaborative setting**

Group	Pretest	Posttest	Mean Gain Score
High	12.00	75.00	63.00
Medium	23.33	75.00	51.67
Low	31.11	72.22	41.11

From Table 5b, it was observed that all the groups had improvement as observed in their posttest. For instance, high and medium students had highest mean gain scores 63.00 and 51.67 while low level students had mean gain scores of 41.11. This shows that the three groups benefited from the chemistry virtual laboratory using collaborative setting.

## DISCUSSION

This study was conducted to determine the effects of Virtual laboratory instructional package to teach practical aspect of chemistry and find out its effectiveness in individualized and collaborative setting on senior secondary school SSII students in Minna, Niger State.

Hypothesis one showed that students exposed to chemistry virtual laboratory package in Reciprocal Peer Tutoring collaborative setting outperformed their counterparts in individualized settings. These findings agree with the earlier finding of Chandra and Watters (2012) and DeGennaro (2008) who reported that the performance of students in social media for collaborative learning was more effective than the performance of students in social media for individual learning. The study was also supported by Ezenwosu and Nworgu (2013) who reported that students taught biology using peer tutoring performed significantly higher in Biology Achievement Test than those taught biology using the conventional lecture method. It also agrees with the findings of Jibrin and Zayum (2012) who reported that students taught biology using peer tutoring instructional method achieved higher than those taught using expository method. In the same vein, it supported the findings of Agoro and Akinsola (2013) who reported that Pre-service Science Teachers exposed to Science Process skills using Reflective Reciprocal Teaching (RRT) group had higher mean score than those in the Reflective-Reciprocal Peer Teaching (RRPT) and the control groups. The study also agrees with a longitudinal study conducted by Ching and Chnag-Chenm (2010) who revealed that the reciprocal peer tutoring program was been successful in regard to tutors and tutees' achievements, motivation and attitudes of university students at National Formosa University in Taiwan during academic years 2007 to 2009. It also agreed with a study conducted by Waghmare, Sontakke, Tarnekar, Bokariya, Wankhede and Shende (nd) reported that overall 90%

students agreed that the Reciprocal Peer Tutoring (RPT) instructional strategy increased their understanding of the topics they taught in Anatomy. In addition, 92% students agreed that RPT improved their communication skills, which can be applied beyond anatomy to their careers as a future physician.

When examine the effects of virtual laboratory on students' achievement, the results of this study supported the findings of Hwang, Kongcharoen and Ghinea (2014) conducted a study extends previous research by designing the Networking Virtualization-Based Laboratory (NVBLab), which requires collaborative learning among the experimental students. The results show that the experimental group significantly outperformed the control group in two Advanced Labs and the post-test after Advanced Labs. Furthermore, the experimental group's activities were better than those of the control group based on the total average of the command count per laboratory. Finally, the findings of the interviews and questionnaires with the experimental group reveal that NVBLab was helpful during and after laboratory class. The finding also agrees with the finding of Tatli and Ayas (2013) who concluded that the developed virtual chemistry laboratory software and physics virtual laboratory package as effective as the real laboratory, both in terms of student achievement in the unit and students' ability to recognize laboratory equipment. Similar to this finding is the study conducted by Gambari, Falode, Fagbemi and Idris (2013) which showed that the application of the virtual laboratory had positive effects on students' achievements, retention and attitudes when compared to physical laboratory method. Also, the study agreed with finding of Flower (2011) who examined students' perceptions of biology using virtual laboratories. From the findings, students indicate their preference to participate in virtual labs compared to traditional (e.g., face-to-face) labs. The finding of this study is in the same direction with finding of Efe and Efe (2011) who revealed that students taught with the help of computer simulations made statistically significant improvements in their test scores on all six levels (knowledge, comprehension, application, analysis, synthesis and evaluation) of Bloom's taxonomy. Also, it in line with the findings of Tüysüz (2010) which showed that virtual laboratory applications made positive effects on students' achievements and attitudes when compared to traditional teaching methods after exposed to 'Separation of Matter'. Similarly, Pyatt and Sims (2007) reported that the simulated laboratory can serve as a legitimate alternative to the expository, "hands-on" laboratory. Similarly, it concurred with the studies of Mahmoud and Zoltan (2009), Abdulwahed and Nagy (2009), Abdullah and Shariff (2008) and Yaman, Nerdel and Bayrhuber (2008) reported that reported that virtual labs provides handy and cheap way for supporting laboratory education; enhanced students' performance; risen their conceptual understanding and has also contributed to reducing the students' cognitive load. On the same note, Murniza, Halimah and Azlina (2010) revealed that virtual laboratory for biology can support students to explore and visualize the abstract concepts in learning biology especially in "Describing the application of knowledge on mitosis in cloning".

However, the finding of this study contradicts with the findings of Azar and Şengüleç (2010) who found that students' achievements and attitudes towards physics using the computer-assisted teaching method can be more effective than the laboratory-assisted teaching method. Similarly, it did not support the finding of Başer and Durmuş (2010) reported no significant effect among the pre-service teachers exposed to Direct Current Electricity (DCE) in virtual (VLE) and real laboratory environment (RLE). Similarly, Kaewprapan and Suksakulchai (2008) found that students exposed to virtual reality module within one course and traditional lecture within another did not significantly differ in their performance after the treatment. It also disagrees with the finding of Gorghiu, Gorghiu, Alexandrescu and Borcea (2009) who reported that traditional laboratories were more effective, despite the fact that virtual laboratories provided a variety of benefits.

The hypotheses two reveals that there is significant difference in the mean performance scores of male and female students taught using virtual chemistry laboratory package in individualized settings. This confirmed the findings of Gambari, Falode, Fagbemi and Idris (2012) who reported that gender had no influence on the performance of students exposed to physics virtual laboratory during posttest and retention test. It also agrees with findings of Al-Mahmadi (2008) who revealed that the use of virtual laboratory in chemistry is gender-neutral while Plumm (2008) in his research findings revealed that there are significant gender-related differences in performance and interaction style in computerized learning environments.

Hypothesis three showed that there was no significant difference in the mean achievement scores of male and female students taught chemistry using virtual laboratory in collaborative setting. The finding of this study agrees with findings of Annetta et al. (2009), Ajaja & Eravwoke (2010), Gambari, 2010, Kost et al. (2009), Yusuf and Afolabi (2010) and Gambari, Yusuf and Olumorin (2013) who reported that gender had no effect on academic performance of students in cooperative learning. It also agrees with study of Yusuf (2004) who found no significant difference in the performance of male and female students taught using both Cooperative Instruction Strategy and Competitive Instructional Strategy. This corroborate with the finding of Ige (2004) who examined the effect of cooperative learning strategy on senior secondary school chemistry students' performance in solving electrolysis problems in Ilora, Nigeria and found that gender did not have any significant influence on



the performance of students. However, the findings of this study disagree with the finding of Ezenwosu and Nworgu (2013) who revealed that male students slightly performed better than female students when taught biology using peer tutoring. It also disagrees with the findings of Ali, Suliman, Kareem and Iqbal (2009) who conducted a comparative study on gender performance on an intelligence test among medical students and found that male students as a group, scored higher than the female students as a group, the difference was small but statistically significant ( $p = 0.015$ ). Furthermore, it disagrees with the findings of Cavallo, Potter, and Rozman (2004) who reported that male students earned significantly higher in final course grades than female students when differences in learning approaches and motivational goals between male and female students enrolled in college physics were investigated. Contrary to those studies in favour of male students, Britner (2008) reported that females earned higher grades in Life science, but scored lower in self-efficacy and more anxiety. In physical science, there were no gender differences in grades or self-efficacy, but females reported more anxiety. Self-efficacy scores predicted science grades for males and females. Similar to Britner (2008) findings DeBacker and Nelson (2001) also reported that female students scored higher on measures of future value and teacher pleasing goals than male students. Both reports disagree with the findings of this study.

Hypotheses four showed that there was no significant difference in the mean achievement scores of high, medium and low students taught using chemistry virtual laboratory in individualized setting. This finding agrees with the findings of Anyanwu, Ezenwa, and Gambari (2013) who found no significant difference in the posttest mean scores of high, medium and low achiever students taught using computer Animation with Text. It also agrees with Borge (2006) who found no significant differences among students of different ability grouping. However, it disagrees with the findings of Gambari, Balogun and Alfa (2014) who revealed that high achievers performed better than medium and low achievers respectfully when taught Isometric and Orthographic Projection with Interactive Whiteboard.

Hypotheses five revealed that there was no significant difference in the mean achievement scores of high, medium and low level students taught chemistry virtual laboratory in collaborative setting. This agrees with the findings of Yusuf (2004) who revealed that scoring ability levels of students did not influence their performance when taught Social Studies using Cooperative Instruction Strategy. However, this finding disagree with the finding of Aluko (2004), Aiyedun (1995), Balfakih (2003), Fajola (2000), Gambari, Yusuf and Olumorin (2013) and Ige (2004) who reported significant difference between students of high, medium and low ability level in favour of high and medium respectively. Similarly, the finding agrees with the finding of Gambari (2010) who revealed that students' academic achievement levels had significant difference on their performance in Jigsaw II, STAD and TAI cooperative learning strategy. These significant differences existed among the students in Jigsaw II, STAD, and TAI cooperative learning strategies in favour of high achievers, then medium achievers and low achievers. This finding was supported by Adeyemo (2010) findings after conducting a study on students' ability level and their competence in problem-solving task in physics and found that students' ability had significant influence on problem-solving task. This finding was in line with Abakpa and Iji (2010) who asserted that with the traditional method of teaching, the gap between the achievement of high, medium and low ability students continue to widen.

## CONCLUSION

The application of virtual lab package in collaborative setting in the learning of chemistry was found to be more effective because it enhanced students' performance. Achievement levels (high, medium & low) had no significant difference on students taught using virtual learning in collaborative and individualized settings. Male and female students were affected positively by the use of reciprocal peer tutoring collaborative learning than individualized learning. This implies that collaborative setting is gender friendly.

## Recommendations

In the light findings drawn from the study, the following recommendations are made:

- (i) The use of virtual laboratory in collaborative setting proved to have positive effect on the achievement of students, therefore teachers should be encouraged to use virtual laboratory package in collaborative setting.
- (ii) Collaboration among students should be encouraged to improve sharing of knowledge and skills among themselves.
- (iii) Gender disparity in chemistry students' achievement could be overcome by adopting virtual laboratory in collaborative learning environment.
- (iv) Emphasizes should be accorded to Reciprocal Peer Tutoring in order to bridge the gaps between high, medium and low achievers' students.

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## EXAMINING INSERVICE TEACHERS' MENTAL MODELS ON TEACHING SCIENCE THROUGH ONLINE LEARNING

Amanda M. Gunning, PhD

Assistant Professor of Science Education

HSI-STEM Step up to STEM program, Co-director

Greater New York Wipro Science Education Fellowship, Co-director

Mercy College, 555 Broadway, Dobbs Ferry, NY

agunning@mercy.edu

Meghan E. Marrero, EdD

Associate Professor of Secondary Science Education

Center for STEM Education, Co-director

Greater New York Wipro Science Education Fellowship, Co-director

Mercy College, 555 Broadway, Dobbs Ferry, NY

### ABSTRACT

Teachers' practice is influenced by their own experiences, their existing beliefs –or mental models –of what teaching and learning is. These mental models have been believed to be very persistent and arduous to change. This qualitative case study describes the shift that took place in the practice of teachers after a two-year online fellowship focusing on online resources. Data collected from phone interviews and teachers' writings and coursework illustrated existing mental models at the start of the fellowship, rooted in early education experiences. By the end of the program, participants largely had changed their instructional methods, moving toward more inquiry-based practices and a marked increase in the use of technology in the classroom.

**Keywords:** science and math education; teacher education; professional development

### INTRODUCTION

Changing teachers' practice to incorporate new methods or technology can be a daunting task. Often efforts to do so may be unsuccessful or met with resistance, in part due to an individual's strong sense of how teaching should be done, based on personal experience. Although resistant to change, existing mental models for teaching are not impermeable. This study examines how teachers taking part in an online professional development fellowship alter their practice and ultimately adjust their mental models for teaching to include new methods and technology.

### THEORETICAL FRAMEWORK

#### Mental Models

The term 'mental model' was coined by psychologist Kenneth Craik in 1943 to describe how a person creates expectations of a given situation in one's mind. Mental models are built through experience and can be extraordinarily complex. They influence the way an individual solves a problem and behavior (Gentner and Stevens, 1983; Johnson-Laird, 2001). Teachers' methods of instruction and how teachers interact with learners are both rooted in the mental models teachers possess, which research has shown are more influential than their content knowledge (Strauss, 2001). Clandinin and Connelly's (1985, 1986) research into teacher narratives illustrate how the teacher cannot be thought as separate from his or her own knowledge – that his or her ways of teaching are as deeply personal as one's own life story. That view lends itself to why these mental models are persistent, because they are rooted in one's individual experience. Pajares (1992) explains how difficult it can be to alter existing mental models. Teachers are considered 'insiders' in their field, because they are not strangers to the classroom. Unlike a surgeon, for example, teachers have grown up going to school in nearly every case, whereas a surgeon may not ever enter an operating room until adulthood. 'For insiders, changing conceptions is taxing and potentially threatening. . . . [they] have commitments to prior beliefs, and efforts to accommodate new information and adjust existing beliefs can be nearly impossible' (p. 323). Lortie (1975) makes a similar argument and explains how 'those planning to teach form definite ideas about the nature of that role' (p. 65) through experience starting at a young age and socialization. Others have found that mental models or existing beliefs about teaching can be very resistant to change (Block & Hazelip, 1995; Patrick & Pintrich, 2001; Richardson, 1996; Woolfolk Hoy & Murphy, 2001). But there is a body of literature that details interventions aimed at altering teachers' beliefs or mental models. Some preservice science methods courses have utilized various means such as: reflection (Bryan & Abell, 1999), dialogue (Harrington & Hathaway, 1995), and through a book club, which combines both critical dialogue and reflection, (Moore, 2008b). Further, the expansion of existing mental models has been documented through research on preservice programs (Anderson 2001; Author, 2010; Hollingsworth, 1989; Wilke & Loshe, 2012).

### **Professional Development and the Fellowship Project**

Research shows that effective professional development for educators engages them in tasks relevant to their classroom practice, such as examining student work or developing unit plans or rubrics. Teachers must be given the chance to perform their own investigations, and also to engage in professional discussions about their learning with other educators (Avalos, 2011; Ball & Cohen, 1999; Lumpe, 2007). Providing teachers with occasions to build strong understandings of science content and process, as well the opportunity to practice with these new ideas assists teachers in bringing inquiry-based practices into their classrooms (Jeanpierre, Oberhauser, & Freeman, 2005). Instructors must hold high expectations for participants, requiring them to demonstrate proficiency with new ideas. A large scale study (Supovitz and Turner, 2000) showed that science teachers engaged in intense professional development used inquiry-based practices and implemented a more investigative classroom culture significantly more frequently than those who did not participate in such experiences. A review of 360 studies over 25 years found that those teachers that are given the opportunity to learn through a long-term (more than one year), constructivist approach to professional development in which teachers learn by doing and using inquiry-based practices themselves have been shown to be significantly more likely to incorporate inquiry and technology-based teaching practices in their own classrooms (Gerard, Varma, Corliss, & Linn, 2011).

The educators in this study were inservice teachers who were a part of a program we refer to as simply the fellowship here, a national competitive fellowship program (*name and additional details revealed following peer review of this article*). Fellows complete a series of five online graduate courses aimed at improving classroom instruction in the science, technology, engineering and mathematics (STEM) disciplines. The fellowship program and this study were built upon the framework of social constructivism, in which learners share their own world experiences and intertwine them with those of others, in this case, other fellows. This approach is valuable for students, as well as teachers (Eun, 2008). Knowledge is therefore collaboratively constructed through interaction and knowledge-building between teachers (Richardson, 1997). This framework means that, 'there are social aspects of the construction process; although individuals have to construct their own meaning...the process of constructing meaning always is embedded in a particular social setting of which the individual is a part' (Duit & Treagust, 1998, p. 8). Fellows were always encouraged to share their ideas and experiences, which were used for starting points for learning (van Driel, Beijaard, & Verloop, 2001). Teacher co-learning has been shown to be an important aspect of quality professional development, whether online or in person (Archambault, Wetzel, Foulger, & Williams, 2010; Avalos, 2011; Timperley, Wilson et al., 2007).

The fellowship program was designed to provide a high quality, intensive professional development experienced based on research in the field. Throughout their coursework, fellows were given multiple opportunities to build and reflect upon their content knowledge and STEM pedagogical strategies, such as inquiry-based science lessons, engineering design, and incorporating technologies (e.g., visualizations, podcasts, data analysis tools) to improve understanding of concepts. Each instructor stressed the importance of these and other practices, and gave fellows opportunities to try out ideas, and then reflect on them with both instructors and other fellows. The five-course series provided frequent opportunity for learning, reflection, discussion with outside experts, i.e., instructors and professionals in the STEM fields, and had clearly stated goals, all hallmarks of excellence in science teacher professional development (Timperley, Wilson et al., 2007).

### **Online Learning for Teachers**

Studies indicate that online professional development is at least as effective as in-person training, and also less expensive and more efficient (Barker and Brooks, 2005, Schmeekle, 2003). Distance learning courses can, however, result in feelings of isolation, and therefore interactions between students, as well as between students and instructors were critical design components of online courses to mitigate this feeling of disconnectedness (Northrup, 2000; Threlkeld & Brzoska, 1994). The fellowship program is very unique in that it brings teachers and instructors from across the country together through the use of a blended model of synchronous and asynchronous technology, which has been shown to be effective in both engaging educators and allowing for meaningful discourse between participants and between participants and instructors. Teachers tend to appreciate the flexibility of this model (Author, 2010). Carr-Chellman (2000) also notes the importance of synchronous interactions, which,

. . . include a more direct sense of collegial interaction, immediate resolution to questions posed, and possibly a strong contribution to the team building required to sustain future student interactions. The synchronous mode is particularly appropriate for the inclusion of motivating guest lectures in specific content areas. (p. 236)

Guest lecturers in the fellowship courses included practicing scientists, mathematicians and engineers. These experts were included in order to give fellows practical applications to the STEM fields. Design of the courses reflects the research in

online training, although most studies refer to asynchronous interactions, e.g., using message boards and recorded lectures. Research also notes that online courses can be very relevant to teachers' classroom experiences (Mackey, 2009), and that teachers view online professional development as meaningful (Duncan-Howell, 2010). Like in other forms of teacher professional development, online instructors should take the role of a facilitator, assisting the teachers through their own learning processes (Palloff & Pratt, 2011).

## RESEARCH QUESTION

The purpose of this study was to examine the role of mental models during a reflective, teacher-chosen professional development. Participants applied to the competitive fellowship and, as part of their coursework in the fellowship, shared reflective writings on both their own learning experiences as children and on their teaching practice. These data, combined with other artifacts, allowed researchers to understand the participants' mental models at the start of the fellowship and provided opportunities to revisit what these models looked like for their instructional practice during, and at the end of the fellowship. We sought to discover: In what ways are teachers' mental models of teaching influenced by participation in an intensive online fellowship program?

## METHODOLOGY

To learn more about reported changes in teachers' practice during the fellowship and how they might relate to teachers' mental models on teaching science, this qualitative case study was constructed to examine the experiences of 14 inservice teachers who had completed a STEM teaching certificate program as part of a fellowship. Through analyzing coursework of the participants, exit interviews and surveys, the case is drawn for the group as a whole, while highlighting individual participants to provide details about their experiences. The study was conducted over two years, during their fellowship. The researchers had contact with all of the participants through coursework, phone conversations and email.

### Case Study

The approach of interpretive case study education was selected to share findings with the community of teacher-educators (Guba & Lincoln, 1981). This method of analysis and sharing findings allow the researchers to utilize 'description, interpretation' and 'identif[ication] of recurrent patterns in the form of themes' (Merriam, 1998, p. 12) to richly describe the case. The case was bounded as the members of the first cohort of the fellowship program who responded to the survey and was drawn specifically around three members who also participated in phone interviews. The data collected was chosen to illuminate the experiences, attitudes and practices of participants in their own words.

### Setting & Participants

This study was conducted during a two-year fellowship program called simply the fellowship in this paper. In this 5-year funded initiative, fellows were competitively selected to participate in the two-year online program. The ultimate goal of the project was for educators to become highly-qualified science teachers, as designated by the US government (For a teacher to be 'highly-qualified,' he or she must hold a bachelor's degree in the given subject area; hold full licensure by the state in which he or she teaches; and demonstrate core competence in the subject area taught (US Department of Education, 2004)), in their state and to enact change in their classroom, school, and school district in order to inspire and prepare more students for STEM careers. This study examined the experiences of 14 of these fellows. The American male and female fellows in this study taught in various states across the country and included elementary generalists, special educators, gifted educators, teachers of all science disciplines, technology and math teachers. Fellows also ranged in years of experience, from first-year teachers to those nearing retirement and represented diverse ethnicities. The fellows took five graduate courses while teaching full-time and earned a Certificate in STEM Education. The five courses included two required pedagogically-based courses and three STEM elective courses. All courses were held online using a blended synchronous and asynchronous model that included 4-6 live sessions as well as structured discussions and other assignments. The online learning system included many common features seen in asynchronous online learning environments including discussion boards, blogs, quizzing and grading capabilities. It was served as the center of all interactions between fellows and instructors as well as between fellows. Discussion boards within the online learning system had a feel that is a hybrid of traditional asynchronous systems (i.e., Blackboard WebCT) but with a social networking flavor. Each discussion post is accompanied by a photograph or avatar of the fellow and viewing each person's profile requires just one click.

### Data Collection & Analysis

All of the data for this study was collected remotely – either by phone or via the Internet, through an online learning system, an online survey generator and email. There were three main sources of data: semi-structured exit interviews via phone, an



electronic survey and teacher coursework. The coursework examined included course discussion posts and particular assignments, such as a science autobiography that participants wrote at the start of their fellowship and an action research project they completed at the end of the program. In addition, the researchers' own experience as instructors for the fellowship allowed us to reflect and observe the participants during the two years, while we interacted with them through the fellowship. This relationship can be viewed as one of a 'researcher teacher' doing 'self-study research' in that the researchers were studying the program as a whole, in which they were each teaching several of the courses that comprised the program (Roth, 2007, p. 1210). This type of relationship is desirable, as it 'brings teachers' voices into the larger science education research community' (p. 1219) as well as increases the rigor of the study, due to the 'long-term observation' (Merriam, 1998, p. 204) of participants and the intimate knowledge of the program studied by the researchers, giving them 'insider status' (Roth, 2007, p.1210).

To analyze the data, electronic files of participant coursework were sorted into folders for each participant and coded openly for broad categories and themes, utilizing Atlas TI. Similarly, interview transcripts were made from digital recordings and also sorted and openly coded. It was not until this first pass of coding was completed that the theme of mental models clearly emerged. Once that theme was recognized, the entire set of data was again coded; using the lens of mental models, and additional questions arose. At this juncture, a survey was created through Survey Monkey and was distributed to participants. This survey consisted of several open-ended questions allowing a free response. The responses were sorted and coded and then compared both among participants and within a participants' own set of responses. During the analysis, the researchers' own experiences with each participant and within the organization helped to construct and organize findings.

## FINDINGS

The data sources revealed that teachers reported, in many cases, drastic changes in their practice after participating in the online fellowship. Particularly, teachers said they used a more inquiry-based approach to science teaching and utilized more technology or technology in a more advanced or meaningful way. It was also noted that many teachers' experiences in science as a child were later played out in some form in their teaching practice, which was then altered in some way after the fellowship. These findings point to a change or shift in participants' mental models of science teaching.

The data from the questionnaires revealed that the majority of participants did not have access to technology or inquiry-based activities during science class as students in grade school, nor did their own science lessons utilize technology or inquiry practices. Although 'hands-on' activities were mentioned by half of respondents, only one teacher reported an inquiry experience as part of grade school science work. The technology experienced by participants as young learners was limited: six reported having viewed film strips and VHS, two experienced overhead projectors and transparencies and one reported the use of a telescope.

These experiences largely laid the groundwork for future practice: Hands-on work was cited as utilized by six of the seven that experienced hands-on work themselves. Of the 14 participants, five mentioned presenting inquiry lessons at some point during the school year to students during their teaching at the start of the fellowship. The frequency of these lessons during the school year was for only one or two topics of study for two teachers, often for another teacher 'because of focused professional development,' and not specified for two teachers. However, none of these inquiry activities were cited to utilize technology. Some examples of participants' reporting of their STEM teaching practice before participation in the fellowship:

*Dan:* 'My typical lesson was hands-on but they were isolated one-offs.'

*Patty:* 'I tried to orient my lessons around hands on activities, but they were more like following a recipe where everyone was supposed to have the same outcome.'

*Joe:* 'Read and discuss text and answer questions'

*Anna:* 'We took notes, built models, and read out of the book'

*Lori:* 'A typical lesson was more script based, by the book, with a pre determined outcome. I would present instruction in a step by step manner without deviation'

In contrast, the technology use of the teachers was vastly different from their own experiences, likely because of the availability of computers and internet access in recent years. The technology the majority (ten) of participants mentioned using with their students largely included computers or SmartBoard technology (three). Other forms of technology mentioned individually, each by different teachers, were: document camera; digital probes; and overhead projector. However, the types of activities conducted using the computer was limited to viewing videos, PowerPoint presentations, webquests and student research. For example, some teachers responded:

*Kim:* 'The typical lessons that were provided by the district had some websites and overheads that were

reproductions from the workbook.'

*Lori:* 'My science lessons would include students making a picture on the computer using stamper tools and typing vocabulary words from the lesson.'

*Patty:* 'The only technology I would use with science was a Smartboard. It was a good way to gather data and have students participating in showing their results.'

*Joe:* 'Computer labs for research and smart board lesson made by me to teach. Notes with short video clips from sites like Teachersdomain.org.'

*Charlie:* 'Use of YouTube as 'engage' for students, PowerPoint review presentations, Document Camera to show student work, on a daily basis.'

After their completion of the fellowship, the majority of participants reported dramatic changes in their practice. All participants reported an increase in the frequency of or the inclusion of inquiry lessons (except for one teacher who had recently changed jobs and was solely doing test preparation), with two teachers reporting they now use inquiry 'daily' and with every science lesson compared to none before the fellowship.

*Nancy:* 'My typical lessons are very detailed in inquiry base learning and hands-on manipulatives with use of graphic organizers and SMART BOARD materials.'

*Patty:* 'A typical science lesson now is much more inquiry oriented. I give students a chance to explore the concept in some way to generate their own ideas and uncover misconceptions first, then I help them acquire some content in the concept before having them explore their own questions within the parameters I set.'

*Kim:* '[Three] days a week is the typical for inquiry lessons, however they usually build on each other throughout the week.'

The majority of participants also cited increased use of technology in varied, seemingly more meaningful ways, including the use of specific instructional tools they learned through the fellowship.

*Dan:* 'I infuse lots of technology now. My students write reflective blog entries about their week. They research online. They will soon be creating videos in class. They document their lab experiences digitally. They have online discussions about what goes on in class.'

*Patty:* 'I no longer have a smartboard, so I don't use that for my lessons. I do incorporate 3D view lessons and plan to use the data from Signals of Spring in a long term project this spring.'

*Anna:* 'I use several NASA programs such as AstroVenture'

*Lori:* '[An] example lesson is a rocketry unit I do with 5th grade. Students are put in teams. . . . Students also explore flight and rocket structure through creation and testing of straw rockets. Student then use laptop computers to research design ideas for creating a water bottle rockets. They agree upon a design, create the rocket, then we have a launch day to test them and discuss results.'

A theme of increased use of inquiry and technology in the participants' classroom was evident through their responses to the open-ended questionnaire. Although inquiry lessons and technology were not foundations of their own education in science in grade school, the teachers' experiences through the fellowship played a role in changing their teaching practices. These changes, as they relate to the program were also evident in the other data sources.

**Lori.** Lori has a passion for hands-on science and utilized animals as a vehicle to getting students immersed in the subject. She provided experiences for her second graders of caring for animals in the classroom, lessons relating to the animals she keeps on her farm, marine science materials made available from Sea World (which is not far from her school) and agricultural lessons related to 'growing crops.' Despite this rich context, in her survey she explained: 'I didn't do any inquiry based lessons due to lack of understanding how to guide them as well as fear of the unknown, so to speak.' She has since become the computer teacher for her school and at the start of this program one of her goals was to bring in more math and science to her lessons. Lori explained in her science autobiography:

Formal science education as a child was rather sketchy, but growing up on a farm created its own living, breathing scientific community and my main instructor as I learned first hand how animals survived, gave birth and raised their young, how crops grew and what it took to manage those crops. . . . Once I started my career as a second grade teacher, . . . I incorporated my farming background as kids cared for various animals in the classroom . . . I occasionally brought my own animals to share when opportunity allowed. I also taught my second graders about growing crops, and eating them as they learned to make strawberry jam.

It is clear the Lori drew upon her mental model of learning science through agriculture experiences as the best way to teach science to her young students. Her own experience and resulting mental model provided a powerful influence on her instruction.

Lori, who was enthusiastic about agriculture in the classroom, found the fellowship was helpful in giving her tools to have students develop knowledge on their own. Similar to her account of bringing animals into the classroom, she ‘brought’ polar bears and reindeer to her students through an online research project she learned about through [the fellowship]. This extended project, including an online symposium in which students were able to share findings with students in other states, Lori showed that her original mental model of using nature and animals to promote science learning was adapted to use online resources. This change made her feel that students were getting more out of the experience, allowing them to be investigators:

I am learning how to set up my projects and situations to where they are developing more ownership of what they’re doing and learning to be investigators themselves instead of me feeding it to them.

The dramatic shift from being hands-on in the classroom or on the farm, to being online to learn about animals clearly represents a change in how Lori believes science can be taught and learned. Her statements about students doing their own investigations demonstrate that she believes science can and should be learned this way: using tools gained from her fellowship experience. This is a big mental model adjustment, but although it is a change, her fundamental ideals about teaching science remain intact, channeled through this new resource.

**Anna.** In her science autobiography, Anna talks about her deep and life-long interest in the ‘natural world.’ After being dissuaded from a career in wildlife biology by a counselor who did not think it was a good choice for her because of her gender, Anna worked briefly as a social worker and then became a teacher. She has now been teaching for six years, and teaches all of the fourth grade science in her school. Even though she is a leader in science instruction there, the majority of her lessons before the study were not inquiry-based and she felt uncomfortable with inquiry activities. Despite her inclusion of hand-on lessons and animals and insects, particularly, in the classroom, she sought more training in science instruction and was pleased to be accepted to the fellowship.

In her science autobiography, Anna vividly recalled her childhood science experiences involving insects, fish and crustaceans. As a fourth-grade teacher, she tries to excite students by using similar creatures in her lessons:

From the time I could walk, my parents took me to the Platte River and explored. Every year when the Platte would go dry and leave little pools, we would head down there with our dip nets and see what was left behind. We would catch crayfish, minnows, leeches, and sometimes large carp which we would set free into the channel. It was great fun. ... My mom, since we had chickens that set on their own eggs would talk to us about what was going on in the egg, help the babies out of the eggs, and sometimes go bug hunting with us just for fun. ... My parents got me a microscope set with a dissection kit, specimen jars, and brine shrimp! I thought I was in heaven! Those brine shrimp were the most interesting thing that I had ever seen up to that point in my life, and I had great fun with them. ... I love to show children things that they have never been exposed to before ... In my classroom I have a colony of Madagascar hissing cockroaches. Kids are fascinated by those large insects. The girls that squeal at them at the beginning of the year soon learn that they are nothing to fear. I also bring a Garter snake in every year

Anna’s account illustrates how existing mental models formed from experiences learning science provide a model for instruction. Similar to Lori, Anna reported that her teaching practice changed dramatically after her involvement in the Fellowship, but still harked back to her previous experiences. Anna shared in her survey that her science lessons before the fellowship consisted of ‘tak[ing] notes, build[ing] models and read[ing] out of the book.’ Her capstone project for the program, an action research study, focused on inquiry and hands-on experiences with insects for her students to explore female students’ feelings about bugs. She has also increased the frequency of inquiry lessons from once a school year to two to three times per month. Although Anna reports she is ‘still uneasy’ with inquiry, it is clear that her professional development experience played a large role in changing her practice and her mental model of what science teaching should be.

**Patty.** Patty has been in the classroom for more than eight years, but this is actually a career change for her. She worked as a physical therapist for 18 years and then went back to school to become an elementary school teacher. In addition to her time in the classroom, she also teaches an after-school science magnet program and has been a science specialist. Even though she is an experienced science teacher, before the study, Patty described hands-on activities she conducted with students as formulaic in nature and with one desired outcome. She did not attempt many inquiry activities in her practice and, according to her survey, felt like she ‘didn’t really know what [she] was doing.’

Patty cited in her survey that she did not remember any elementary science experiences and explained in her autobiography that her mental model for teaching in general arose from her experience with patients in her former career:

Both my training and work ... showed me what scientific thinking was about. Early on, I learned to evaluate patients

and rely on the data I collected (both subjective and objective) to formulate working diagnoses and treatment plans. As a young physical therapist, the information I gathered often felt disconnected as I struggled to understand the significance of individual tests. As I became more experienced and adept at evaluation, patterns began to emerge and I saw connections between seemingly incongruous pieces of information when I would evaluate and treat patients. . . . Developing an effective treatment plan was like putting the pieces of a puzzle together. . . . Physical therapy was a constant interplay between evaluation and treatment. For me, they went hand in hand. . . . As my footing as a teacher became firmer, I began to apply what I'd knew about people and learning from my days a physical therapist to my teaching. I really worked at evaluating students and their response to learning on many different levels. What were they good at? What type of learner were they? What skills did they have? How could I help them feel successful? What could I do to help them connect to learning? . . . I was still thinking like a scientist and applying those skills to my new situation as a teacher.

Patty has a strong mental model of utilizing evaluation techniques and familiarity with her students to drive her practice. Through the fellowship, she was able to change that model to incorporate inquiry practices. Patty feels strongly about this new direction in her teaching, so strongly that she is sharing it with her colleagues and administration.

What I learned both from the methods class and the research I did - in terms of what's considered best practice right now for teaching science - using an inquiry approach, meta-cognition all those kinds of things. So that's what I share with my teaching colleagues and I also shared with Administration... kind of a perspective of what STEM is and how, how integrated science teaching is really important for kids in terms of making sense in science.

While Patty cites assessment as an integral piece of her instruction even after the study, in her interview, she expresses how she feels a dramatic change in her teaching has occurred: 'My teaching is completely different; I feel confident using an inquiry approach now where I didn't before.' This shows that her mental model of how to teach science has shifted, making inquiry an important part, which she now feels comfortable doing.

## DISCUSSION

The goal of this study was to examine teachers' mental models as they participated in an intensive fellowship program that focused on the use of inquiry and real data with students. The findings suggest that two-year online-based program played a role in teachers' mental model change. A review of literature illustrates the difficulty in making changes to mental models (Lortie, 1975; Pajares, 1992). Through interviews, coursework and a questionnaire, it was noted that major changes in teaching practices were evident, especially in terms of utilizing inquiry and technology activities with students. These shifts in practice can be related to changes in their mental models of what science teaching looks like. The progress illustrated in this study is particularly interesting as the use of technology in the classroom increases, which is a departure from the way most teachers learned science.

Participants in this study were in grade school before the advent of the widespread use of computing for personal and educational use. These teachers largely did not learn science in school through technology nor inquiry practices. Some of the teachers did have hands-on school experiences that were not inquiry-based. We are proposing these school-based experiences in learning science had created mental models of science teaching that did not include the use of technology nor inquiry, which was evidenced through participants' own descriptions of their teaching practice before the study. Research shows that teacher beliefs about technology and student learning affects how they use technology to support curriculum (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012; Ertmer & Ottenbreit-Leftwich, 2010; Kim, Kim, Lee, Spector & DeMeester, 2013). The experiences in the present study, although nearly completely online, encouraged and supported the use of both technology and inquiry in the classroom. This was accomplished through coursework, mentoring and peer interaction. Several participants' teaching changed dramatically, moving from no reported inquiry lessons to daily use of such teaching. Also, the use of technology to do inquiry or support inquiry activities also was reported, which can be interpreted as an increased familiarity and affinity for use of both. The data suggests that the fellowship experience was meaningful enough to spur a change in practice, which we are correlating to a shift in teachers' mental models.

It is also interesting to note, that several of the participants did have informal, out-of-school inquiry experiences that may have laid the groundwork or perhaps pre-disposed them to utilizing inquiry in the classroom, once the connection of how to do that was made clear. Although outside the scope of this paper, this is an important point, since connecting to existing schema and ideas about successful learning, even informal, self-directed childhood exploration, can be valuable (McPherson, 2014). Clearly, more research would be needed to explore this idea.

A compelling point that surfaced is for the teachers Lori, Anna and Patty detailed specifically here, strong existing mental models about the way science teaching should be carried out did not disappear, but instead accommodated the new mental

model or shift in mental model. This outcome resonates with the literature that states mental models are extraordinarily hard to change. As reported by the teachers themselves, clearly, practices and mental models DID change, however the change remained within the parameters of original mental models of science teaching (animals, insects, and evaluation). This trend in the data is important to note because it shows both how powerful mental models can be, yet also that they are not impervious. This finding is in line with prior research on preservice teachers who integrated new content into and expanded upon their existing mental models through their teacher education programs (Hollingsworth, 1989; Anderson, 2001). The significance of existing models being malleable in terms of expansion is important to note, as this may be a significant entry point for professional development and growth.

The unique features of the fellowship studied here provided an environment that was rich with both pedagogical and social resources, despite being conducted in its entirety online. In addition, coursework often required reflective pieces to be written; where teachers had the opportunity to think about their practice and how new resources and/or techniques could be implemented in their own classrooms. In general, courses offered choice for assignments and those assignments were largely related directly to an individual's own practice or students. The fellowship provided a forum for teachers to discuss these ideas and projects with other teachers in the fellowship. Professional development literature (Ball and Cohen, 1999; Borko, 2004; Hewson, 2007) cites these as desirable qualities and our findings suggest this highly personal fellowship was very effective in providing an environment where teachers could learn and grow. Teacher growth has been related to shifts in beliefs and mental models in other studies (Bryan & Abell, 1999; Bryan & Atwater, 2002; Moore, 2008). The findings here indicate that there may be a connection between teacher growth and learning and mental model shifts. This blended online format has already been found to promote the growth of professional communities of teachers who share best practices as well to help teachers of science strengthen their conceptions of the Nature of Science and identify and clarify student misconceptions (Author, 2010),

## CONCLUSION

All teachers enter the classroom with preexisting beliefs and mental models built from their own experiences that can influence their methods of instruction and expectations of learners (Calderhead & Robson, 1991; Moore, 2008b; Nespor 1987). These existing mental models can be very difficult to change (Lortie, 1975; Pajares, 1992), but some recent studies have found a belief shift may be possible (Bryan & Abell, 1999; Bryan & Atwater, 2002; Harrington & Hathaway, 1995; Moore, 2008). The findings of this study provide support to that idea.

After a two-year, interactive, online fellowship program, teachers provided evidence of teaching practices that had shifted, and in some cases significantly, in terms of inquiry approach and the use of technology. The teachers who participated in this study were not educated in a time when computers were used to aid instruction in grade school and largely did not utilize computers or the Internet in their own teaching. Finding ways to help teachers become more comfortable using digital resources is a challenge. 'The single biggest problem facing education today is that our Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language' (Prensky, 2001, p.2). This study provides an example of a model that was successful in providing experiences that that fostered teachers' integration of digital resources into their instructional practice. Generally, this study raises questions on how to help teachers adjust their mental models, which is also important for examining how teachers may learn to incorporate more digital resources in the classroom. We see that providing a learning environment that connects to the new methods, coupled with reflection, can help foster change.

Existing mental models about the way science should be taught were evidenced through teachers' science autobiographies and questionnaire responses. However, due to the nature of the fellowship, where online resources were explained and showcased, participants were able to incorporate these new ideas and actually change their practice. This is a compelling outcome that adds to the growing body of literature that shows changes can be made in teachers' preexisting beliefs, in particular in regard to inquiry-based instruction and the use of technology. These findings suggest that additional research is warranted to uncover what exactly helps facilitate these types of shifts and how preservice education and inservice professional development can better utilize those methods to help support teachers' growth as practitioners in the digital age.

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# INFORMING STUDENTS ABOUT BULLYING THROUGH THE DEVELOPMENT OF DIGITAL STORIES. RESULTS OF A PROJECT IN GREECE

Emmanuel Fokides

University of the Aegean, Department of Primary School Education  
1 Dimokratias str., 85132, Rhodes, Greece  
fokides@aegean.gr

## ABSTRACT

The study presents the results of a project in which third-grade primary school students developed their own digital stories and through this process, they advanced their understanding of what bullying is. The constructivist principles concerning the learning process, and in particular, the requirement of students' active participation, provided the necessary framework. Participants were 132 students, from six schools in Athens, Greece. Their teachers, although present, avoided guiding or lecturing them. Data was obtained by analyzing students' digital stories, the short essays they were asked to write after the intervention, and a short test that tried to determine if they could make the distinction between bullying and non-bullying situations. The results indicated that students were able to grasp what bullying is, its main aspects and how they should react, but they were not able to accurately portray the role of bystanders. The intervention was short in duration and can be easily applied, without altering the school's timetable. The results of the study might prove useful when designing more comprehensive anti-bullying programs.

**Keywords:** bullying, bystander, constructivism, digital storytelling, victim

## INTRODUCTION

Digital narrations are a powerful tool in the hands of educators. They cause the keen interest of students and thus, they can easily assimilate information (Coventry, 2008). They foster literacy skills as well as artistic and social skills, they strengthen critical thinking, and the ability to analyze and synthesize information (Robin, McNeil, & Yuksel, 2011). Digital storytelling combines the creative work of constructing a story, together with the use of technology. This, in turn, allows students to acquire a wide range of skills and abilities (e.g., creative thinking, collaborative skills, communicative skills, flexibility, taking initiatives, leadership) that all of them fall under the term "21st-century skills" (Czarnecki, 2009). Students also learn to voice criticism either on their own work or on the work of others, facilitating social learning (Robin, 2008).

Extensive research has been conducted on the educational benefits when using digital storytelling. There lies a contradiction; while researchers focus on the instructional settings, the improvement of literacy skills and on knowledge acquisition, at the same time they acknowledge that the benefits of digital storytelling go far beyond these objectives, as presented above. In addition, far less research has been conducted on examining the potential of this tool in other areas where the settings are not strictly instructional or the main objective is not some form of knowledge acquisition. Such areas could be aiding or counseling students, acquirement of behavioral patterns, and the resolution of complex problems. The underlying philosophy of such uses of digital stories is that they are a good method for documenting personal experiences, that they can be a form of narrative therapy and that they can help students to discover parts of their personality (Sawyer & Willis, 2011). The pilot program presented in the following sections embraces this standpoint. It examines how digital storytelling can be used in raising students' awareness on bullying, a phenomenon that students, as well as teachers, quite often face at school. Knowledge acquisition was not an important factor; instead, the focus was on assisting students to understand how to deal with this issue and how they can assist others that might need help.

The paper is organized as follows. First, a brief review of the literature regarding bullying and bullying prevention programs is presented, followed by the project's rationale and methodology. Subsequently, results are discussed and the conclusion completes the work.

## DEFINITION OF THE PROBLEM

Intimidating and aggressive behavior, school violence, and bullying are phenomena that are becoming more and more frequent in Greek schools. They greatly affect students' attitudes and behavior, psycho-emotional development, and their school performance (e.g., Bond, Carlin, Thomas, Rubin, & Patton, 2001; Glew, Fan, Katon, Rivara, & Kernic, 2005; Ortega, Elipe, Mora-Merchán, Calmaestra, & Vega, 2009; Juvonen, Wang, & Espinoza, 2010) and may lead to serious psychological trauma and dysfunctional social behavior (e.g., Frizzo, Bisol, & Lara, 2013; Gini, 2008). The victim is weaker and powerless compared to the abuser. The attacks are



programmed, repeated at regular intervals and the abusers' objective is the affirmation of their power over the victims (e.g., Atlas & Pepler, 1998; Bond et al., 2001). School violence, as a social phenomenon, has a close relationship to social discrimination, social exclusion, and cultural diversity (Garnett, Masyn, Austin, Miller, Williams, & Viswanath, 2014; Nikolaou, Thanos, & Samsari, 2014). In general, the occurrence of bullying in Greek schools is lower than in other countries, however, it becomes more and more frequent (Sapouna, 2008; Houndoumadi & Pateraki, 2001). It usually lasts for a short period of time, but for 19% of the incidents, it can last for more than a year (Artinopoulou, 2010).

In a bullying situation, individuals assume the roles of bullies, victims, and bystanders (Rigby, 2008). While the bully-victim dyad is quite clear, bystanders' involvement is ambiguous (Padgett & Notar, 2013). Bystanders can undertake one of the following roles: (a) actively take the side of the bully and become a source of power to him (Twemlow, Fonagy, Sacco, & Hess, 2001), (b) passively observe and often perceived as approving the bully's actions (Gini, Pozzoli, Borghi, & Franzoni, 2008), and (c) intervene and help the victim or ask adults to intervene (Salmivalli, Lagerspetz, Bjorkqvist, Osterman, & Kaukiainen, 1996). Those who intervene have the skills, the will, the confidence, and the sense of personal responsibility to help, whereas passive bystanders seem to lack all the above (Pozzoli & Gini, 2010). On the other hand, the motives of students who take the side of the bully, seem to be similar to the ones that the bully has (Camodeca & Goossens, 2005). In hypothetical situations (e.g., when they are asked to write an essay or when they respond to questionnaires), children easily take the side of the victim and express their intentions to help or to report the incident (Rigby & Johnson, 2006; Boulton, Trueman, & Flemington, 2002). In real situations, though, only a small percentage actually acts (Salmivalli et al., 1996).

It seems that there are two major categories of programs that try to deal with bullying: (a) narrowly focused, such as curriculum interventions and counseling and, (b) large-scale, whole-school interventions (Vreeman & Carroll, 2007). Such a large scale program is Olweus Bullying Prevention Programme-OBPP (Olweus, 2003), which tries to deal with bullying by utilizing multilayered tactics; providing measures, guiding principles and philosophies, including but not limited to: staff discussion groups, class rules against bullying, meetings with students and parents, talks with bullies and victims, and with parents of involved students, and individual intervention plans. Kiusaamista Vastaa (Against Bullying)-KiVa program, takes an even more holistic approach to the matter (Salmivalli, Kärnä, & Poskiparta, 2011). In addition to the above, it includes students' lessons, sets of tools for educators, students, and parents, and a computer game. What is interesting about KiVa, besides its good results (Kärnä et al., 2011), is that it is a prevention rather than an anti-bullying program, such as OBPP, and that students are more actively involved in the process.

On the other hand, studies that were carried out in Greece, focus on investigating the duration, frequency, and psychological impact of bullying. The problem is that its impact is studied mainly on a theoretical/abstract basis (e.g., Koutras & Giannopoulou, 2015; Nikolaou et al., 2014; Bogiatzoglou, Villi, & Galani, 2012). Large scale prevention programs are sparse (e.g., Andreou, Didaskalou, & Vlachou, 2007). Studies examining interventions where students were not just passive receivers of information but actively participated in the process are even more scarce (e.g., Kyriazis & Zacharias, 2015). One can assume that at least in Greece, the prevention of bullying is still in its early stages.

## **RATIONALE, METHODOLOGY, AND IMPLEMENTATION**

Having in mind the above, together with the view that digital storytelling might prove to be a useful tool in dealing with bullying, a project was planned and carried out in the third grade of six primary schools in Athens, Greece, from late October 2015, till late February 2016 (the project was not implemented simultaneously in all schools). Constructivism provided the theoretical background but also the framework of the intervention. According to constructivism (Ertmer & Newby, 2013): (a) learners build personal interpretations of the world based on their experiences and interactions, (b) knowledge has to be embedded in the situation in which it is used, (c) effective use of knowledge comes from engaging the learner in real-world situations, and (d) knowledge is validated through social negotiation.

On the basis of the above principles, it was considered inappropriate to present students with ready-made digital stories, it would be like lecturing them. Instead, I thought that it would be in line with the constructivistic views regarding how knowledge is constructed if students were asked to create their own digital stories. I also decided, purely for research reasons, that students were going to be provided only with a minimum of information regarding bullying, during the project's initial stages. By doing so, it would be possible to trace changes in their views, but also to examine to what extent they were able to understand by themselves:

- The basics of bullying (types, duration, and roles).
- The right course of action in case they are the victims.

- The right course of action in case they are the observers.

Having set the above as the main research questions, I also came to the decision that the target group was going to be third-grade students (8 year-olds). The underline reasons for this decision were: (a) that younger students might face problems in using the digital stories' developing software, and (b) although bullying is found at all ages, it tends to peak during the middle school years (Monks & Smith, 2006; Rios-Ellis, Bellamy, & Shoji, 2000); therefore, one needs to inform students about bullying as early as possible.

The main idea was students to develop stories regarding bullying without any prior help, discuss their stories with the rest of the class and with their teachers, and re-visit their stories and modify them according to what they were able to comprehend during the discussions. Therefore, the project's stages and the respective methods were:

*Preparatory stage.* Prior to the beginning of the project, students' parents were gathered and they were briefed about the project, its methodology, and objectives. Their written consent for their children's participation was obtained. Written consent was also obtained from the schools' headmasters. The third-grade teachers of the participating schools were also gathered and briefed. They were explicitly asked to follow the project's methodology, as it is further elaborated in the coming paragraphs.

*Preliminary stage* (one two-hour session). At this stage, teachers informed students what they were going to do during the following days and they also discussed with them incidents of aggressive and intimidating behavior at their schools, while they avoided mentioning the term "bullying". Bullying was brought up as a topic of the discussions only when students raised that issue (in all schools they did), but not to a great extent. Naming the roles individuals assume in a bullying situation and offering possible resolutions to the problem were also avoided because students would be given the chance to reflect on these matters on the subsequent stages.

*Main stage,* development of the students' digital stories (two weeks, eight two-hour sessions). The key principles of constructivism together with the roles assumed by the ones involved in bullying, as presented in previous sections, shaped the methodological approach of the intervention's second stage, which had two sub-stages. During the first, which lasted for three two-hour sessions, students learned how to use the software for developing their digital stories. This was necessary in order to avoid problems and delays during the next sub-stage.

On the second sub-stage, which lasted for five two-hour sessions, groups of four were formed and teachers outlined what students were expected to do. After reminding them the discussion they had a few days earlier, they asked each group to think of a scenario which, in their view, constituted a bullying situation, and, by using the developing software, to develop a story based on this scenario. They were also asked to include as many characters as they believe that they are involved in bullying and to give a resolution to the problem. The stories' artistic aspect was not important; what was important was the thoroughness of the scenarios, the thoughts, and dialogues of the story' characters and the resolution that each team was able to come up with. Teachers did not offer any help or guidance and did not intervene in the process, except when technical help was needed.

On a side note, there were some problems when students were asked to develop their own stories. Since, in two schools, students were accustomed to working in groups, where each member assumes a certain role, they thought that they had to do the same when developing their stories and tried to assign roles according to the story's characters. As a result, no one wanted to take the side of the "bad guy" (bully) and, in few cases, they did not want to take the side of the victim either. This is an indirect indication of how young children identify themselves with the characters of a story, especially when it is their "own" story (Appleyard, 1994). In any case, teachers explained to students that each story would be collectively developed and that they all have to contribute in portraying the story's characters.

*Final stage* (two weeks, four two-hour sessions). This stage also had two sub-stages. During the first, all groups presented their stories. These presentations served as a starting point for discussing, in-depth this time, the issue of bullying. Teachers asked questions regarding the scenarios of the stories, the characters in them, and the endings. In addition, having as an example certain key-points of students' stories, teachers pointed out what students accurately portrayed or what they missed to include. At the second sub-stage, students were asked to re-think their stories and, if they considered it appropriate, to make changes to them.

*Post stage* (one two-hour session). At this stage, which took place about a month after the final stage, the issue of bullying was re-examined. First, a set of 17 images created using the digital stories' developing software was

presented to students. Speech bubbles indicated the dialogues between the characters and captions outlined the situation in which these dialogues took place. They depicted aggressive acts of a varied type and intensity (physical, verbal, direct, indirect, imbalance of power, provocation, repetition, and intent). Students were asked if each image illustrated a bullying situation or not. These images were inspired by a set of images which were first used and extensively validated by Smith et al. (2002) and later on by Monks and Smith (2006). It has to be noted that the original set included 25 images, 8 of which were about sexual and racial discrimination and I thought that they were not appropriate for use with younger children. Students were also asked to write a short essay, presenting: (a) their thoughts about how they would have reacted if they were the observers on a bullying incident and (b) how they would have reacted if they were the victims.

**RESULTS ANALYSIS**

In total, 132 students participated in the study (62 boys and 70 girls). Their digital stories (66 in total, 33 initial and 33 after the changes students made) were analyzed using the iterative coding process (Creswell, 2002; MacQueen, McLellan, Kay, & Milstein, 1998) to identify the categories, themes, and patterns that emerged from the data. All stories were viewed once, by two individuals, to identify the main ideas. Then, they were re-viewed in more detail and the ideas were labeled with codes. This process was repeated two more times to reduce overlap and redundancy of the codes, until a small set of sub-themes, under a few major categories, were identified. It has to be noted that the coders were trained prior to analyzing the data and their reliability was assessed: (a) informally (during their training), (b) formally (in a pilot test), and (c) formally during the coding of the full sample. An interrater reliability analysis using Cohen's kappa coefficient was performed to determine consistency among raters. The interrater reliability was found to be  $\kappa = 0.84$  ( $p < 0.001$ ), 95% CI (0.896, 0.784), which was considered very good (Landis & Koch, 1977).

The initial stories although simplistic accurately illustrated what bullying is; the repetition of the incidents, the use of violence and bad language, the abuser's overwhelming power, the victim's reluctance to report the events. Physical together with verbal bullying was the main theme in all scenarios (Table 1). There were no cases of emotional bullying, cyberbullying, and of sexual harassment. Quite interestingly, bullies, in all cases, were boys and sometimes they were portrayed as fat and/or tall, besides being strong; amplifying in that way their overwhelming power. In twelve cases it was also stated that the bully was an older student. There were some notable, changes in students' stories after the in-classroom discussions. Though no other type of bullying was added, there was a shift to more complex types of bullying (verbal and physical). Also, in 4 cases girls replaced the boy bullies, the overwhelming power of the bullies was even more amplified and the recurrence of incidents was also highlighted.

**Table 1.** Bullies

Category	Theme	Initial* N = 33	After** N = 33
Type of bullying	Verbal	6	1
	Verbal, physical	14	24
	Physical	13	8
Gender	Boy	33	29
	Girl	0	4
Characteristics	Strong	14	5
	Strong, fat	7	6
	Strong, older	7	11
	Strong, fat, older	5	11
Recurrence of incidents	2	3	0
	3	10	5
	4	9	11
	5	9	14
	6	2	3

Notes. \* = Initial digital story, \*\* = Changed story, after the in-classroom discussions

In most cases, the victim was a boy (Table 2). The most common emotions were fear, depression, loneliness, embarrassment, and humiliation. Only in two cases the victim immediately reported the events. Once again, there was a notable shift in students' stories after the in-classroom discussions to (a) the complexity of emotions that the victim experienced, and (b) the reaction of the victim because in 16 cases he/she was keen to report the events. Most of the stories ended with the victim talking to a parent (mostly to his/her mother) or to the class's teacher, both before and after the in-classroom discussions.

In students' initial stories, bystanders were included, though in eight of them there were no observers at all. Even so, only in six cases, there were dialogues or thoughts accompanying these characters, so it is impossible to know which type of bystanders were portrayed to the majority of the stories (Table 3). In those six cases, the only emotion that was expressed was fear, because the bully might turn against them. After the in-classroom discussions, students changed their stories; to the majority of them, the observers took the side of the victim, expressing anger and sorrow.

**Table 2.** Victims

Category	Theme	Initial N = 33	After N = 33
Gender	Boy	24	24
	Girl	9	9
Emotions	Fear	3	2
	Fear, loneliness	8	5
	Fear, embarrassment	2	1
	Fear, depression	6	4
	Fear, humiliation	4	2
	Fear, loneliness, depression	5	8
	Fear, depression, humiliation	4	5
	Fear, loneliness, depression, humiliation	1	6
Reports the events during the story	yes	2	16
	no	31	17
Ending of story	Talks to teacher	7	9
	Talks to headmaster	3	4
	Talks to mother	12	14
	Talks to parents	4	4
	Talks to a friend	3	1
	Talks to an adult (unspecified)	4	1

**Table 3.** Bystanders

Category	Theme	Initial N = 33	After N = 33
Included	Yes	25	33
	No	8	0
Type	Passive observer	6	4
	On the side of the victim	0	24
	On the side of the bully	0	0
	Not specified	19	5
	Not expressed	19	9
Emotions	Fear	6	3
	Sorrow	0	9
	Anger	0	12

Students' essays were analyzed using the same iterative coding process as in their digital stories. Three were the key elements for evaluating their them; the reasoning for selecting their own "right" course of action either as bystanders or as victims, the person that one would seek help from, and the time to react. The results are presented in Table 4. Twelve cases (five boys and seven girls) were excluded from the analysis because their essays were incomplete and/or had problems in writing. It has to be noted that either as observers or as victims, students expressed, more or less, the same reasoning for reacting and the same course of action and there were profound similarities with the final versions of the digital stories. What is interesting is that in 23 cases students stated that they will help the victim by intervening and by trying to reason with the bully. What is more, in 11 cases (all boys) students stated that they would react violently, either as observers or as victims, and that they feel confident that they will prevail. What is a cause of some concern is that in 13 cases, students stated that they will not react immediately, but only if the situation becomes intolerable.

Finally, the results from students' responses to the set of images are shown in Table 5. The last column presents the results from Monks and Smith's (2006) study, in which a set of images with the same captions was used,

though they did not use cartoonish characters but stick figures. Some notable differences can be observed, that will be further elaborated in the coming section.

**Table 4.** Analysis of students' essays

Category	Theme	Observers N = 132	Victims N = 132
Time to react	Immediately	110	107
	Delayed reaction	10	13
	Not specified	12	12
Course of action	Talks to teacher	37	28
	Talks to headmaster	22	16
	Talks to mother	6	34
	Talks to parents	4	23
	Talks to a friend	14	4
	Talks to an adult (unspecified)	3	4
	Verbally intervenes to help the victim	23	-
	Violent reaction	11	11
	Not specified	12	12
Reasons for reacting (multiple reasons)	Not good to live in fear	68	78
	Life would become intolerable	55	62
	Not good to be humiliated	75	77
	Others will laugh at the victim/me	58	60
	I can tolerate intimidating behavior up to a point	-	13
	Not specified	12	12

**Table 5.** Students' responses to the set of images

Image	Caption	Type	Bullying Yes %	Ref. %
1	X and Y don't like each other and start to fight	Pa	26.52	90.0
2	X starts a fight with Y	Pa	53.79	92.5
3	X starts a fight with Y who is smaller	Pa/Ip	90.15	92.5
4	X starts a fight with Y because Y said that X was stupid	Pa/Pr	48.48	77.5
5	X starts a fight with Y every break time	Pa/Rp	95.45	95.0
6	X borrows Y's ruler and accidentally breaks it	In	1.5	10.0
7	X takes Y's ruler and breaks it intentionally	In	85.60	60.0
8	X forgot their pen so Y lends them one of theirs	Bp	0	5.0
9	X says something nasty to Y	Va	59.85	85.0
10	X says nasty things to Y every day	Va/Rp	93.18	87.5
11	X makes fun of Y's hair. They both laugh	Ou	0	12.5
12	X makes fun of Y's hair. Y is upset	Ou	53.03	85.0
13	X asks Y if he/she would like to play	Bp	0	2.5
14	X won't let Y play today	Dr	45.45	87.5
15	X never lets Y play	Dr/Rp	91.67	90.0
16	X tells everyone not to talk to Y	Ir	75.76	87.5
17	X tells nasty stories about Y	Ir	87.12	90.0

Notes.

Ref. = Results from Monks & Smith's (2006) study (8 year-olds)

Pa - physical aggression; Va - verbal aggression; Dr - direct relational aggression; Ir - indirect relational aggression; Bp - benign or prosocial; Ip - imbalance of power; Pr - provocation; Rp - repetition; Ou - outcome; In - Intention

Gender-appropriate names were used in the place of X and Y; genders were mixed in the images.

## DISCUSSION

The project presented in the preceding sections used digital storytelling in a way that deviates from its mainstream uses, that is in a strictly instructional framework, for simply telling a story, or for acquiring literacy skills (Robin, 2006; Sadik, 2008). Taking advantage of storytelling's compatibility with young students' mentality (Ohler, 2006), the study examined if it is possible through the development of digital stories to raise students' awareness of bullying.

Bullying is a phenomenon that has to be dealt efficiently and quickly since its implications can be severe for victims (Hawker & Boulton, 2003; Olweus, 1994), as well as for bullies (Nansel et al., 2001). Most prevention programs' objectives, at least in Greece, try to raise awareness by simply informing students (e.g., Bogiatzoglou et al., 2012); their active participation is hardly a feature. In contrast, this study relied mostly on students' active participation in the process, by adopting a constructivistic approach (Ertmer & Newby, 2013).

To the best of my knowledge, students were not previously lectured about bullying by their teachers, and no other anti-bullying programs were carried out at these schools. Consequently, it can be assumed that their initial digital stories were not the result of someone imposing his thoughts and views on them, but a combination of: (a) pieces of previous knowledge and experiences they might have had, (b) their own point of view, (c) their own understanding of what bullying is, and (d) how they think one can deal with it. Their final stories, on the other hand, were the result of the above, plus, whatever effects had the presentation of stories and the subsequent discussions with the teachers and the other students.

By working in groups, students were able to reflect on bullying, to visualize their thoughts when developing the stories, to negotiate their views and knowledge, and to embed the results of this negotiation into their stories, which represented situations where this knowledge and views are used. By doing so, the Piagetian perspective on how knowledge is constructed was implemented (Smith, 2012). Also, by viewing the digital stories of others, students became communicants of someone else's thoughts and feelings and this helped them in having a better understanding of the problem (Cane, 2010). In addition, while during the development of the stories teachers did not intervene, they guided students, through discussions, when each story was presented to the rest of the students, thus, implementing the Vygotskian perspective on learning (Niesel & Griebel, 2007).

It is quite important to have in mind the above when interpreting the results. On the basis of the findings in the initial stories, it can be concluded that students:

- Were capable of grasping, by themselves, the basics of bullying and the emotions one has when being bullied. This is in line with findings of other studies (e.g., Oliver & Candappa, 2003). They were also able to understand that the victim is reluctant to report the events since there were just two stories displaying the opposite behavior.
- View bullying only as physical and verbal harassment. Other types of bullying were not presented, probably due to students' age or because physical and/or verbal bullying is more easily understood as Oliver and Candappa (2003) pointed out.
- Were not able to adequately portray bystanders. It seems that their role needs to be clarified and analyzed to students, as others had pointed out (e.g., Polanin, Espelage, & Pigott, 2012).
- Understand, by themselves, that a bullying situation can be resolved by asking for help from an adult.

On the basis of the findings in the final stories and on the essays, it can be concluded that students:

- Became able to sufficiently portray bystanders, only after discussing their role.
- Were able to show empathy, their emotions for the victim, and their intention to help, only when they were asked to (in their essays). This is in line with other studies which indicated that in hypothetical situations children easily express good intentions (Rigby & Johnson, 2006; Boulton et al., 2002).
- Understood that the bullying incidents must be reported immediately. However, and despite the fact that the majority stated that if they are bullied they will react immediately, this has to be viewed with caution, since, once again, it refers to a hypothetical situation.

The project's positive impact can also be established by examining the results from students' responses to the set of images. Literature suggests that younger students, up to the age of 8, tend to be over-inclusive when they try to define bullying. They do not pay so much attention to the limiting characteristics of repetition, intention, and of the imbalance of power, characterizing acts of aggressive behavior, such as a fighting, as bullying (e.g., Madsen, 1996). Monks and Smith (2006) add that 8-year-olds use just one dimension to discriminate behaviors as bullying or not bullying, that of aggressive and non-aggressive behavior. Contrary to the findings of the above studies, I found that students were able to use at least two dimensions for characterizing aggressive acts as bullying, that of repetition together with aggression (physical or verbal). That is because the differences in the results in images 1, 2, 4, 9, 12, and 14 between my study and that of Monk and Smith are considerable (see Table 5). In these images, the element of recurrence is not present and fewer students, in my study, characterized them as bullying. At the same time, they were able to correctly classify as bullying images that depicted such acts.

On the other hand, the results have to be viewed with some caution, since it is unclear if the project helped students in shaping actual attitudes and behavioral patterns. The digital stories and the essays were all

hypothetical situations. It is unknown how students will react in real situations, but all anti-bullying programs have the same problem (Merrell, Gueldner, Ross, & Isava, 2008; Salmivalli et al., 1996).

The study's findings have implications for practice. The project was short in duration (twelve two-hour sessions excluding the pre- and post-stage) and can be easily applied, without altering the school's timetable. Though it is certain that long term interventions yield good results, time is a crucial factor. Short term innovative interventions are needed because results can be produced right away and problems can be dealt on the spot. In this study, whatever results were attained, were achieved fast, probably easing the way to follow up, longer term interventions. Also, no specialized equipment was needed and software similar to the one that was used is freely available on the Internet. In addition, the simplicity of the study's design allows similar interventions to be easily applied to younger students, though, in such case, an easier-to-use software tool will be needed. Thus, teachers, as well as policy makers, can consider using the study's set-up when designing similar or more well-organized, long-term interventions.

## CONCLUSION

The study has limitations that need to be acknowledged. Even though all necessary precautions were taken, one can never be certain whether students expressed their actual thoughts and feelings on bullying. Since it was limited only to six schools and had a limited number of participating students, its results cannot be easily generalized. Further studies are needed with larger sample sizes and from different educational systems, in order to identify differences or similarities to the findings of the present study and to obtain more reliable results. In addition, since the duration was short, longer-term projects can be tested, examining and comparing their results to short-term projects. Additional data collection tools can also be used, for example, questionnaires and/or interviews with the students. It would also be interesting to conduct research using conventional, instead of digital storytelling and compare the results. By doing so, it would be possible to determine if the results can be attributed to the medium used and/or to the method.

Nevertheless, the results indicate that the project's set-up helped students to understand the main aspects of bullying. By developing their own digital stories, they were able to organize their thoughts, to reflect on that issue and to understand its implications. Besides, since the intervention was short in duration, it can easily fit into a school's timetable, either as a stand-alone intervention or as part of a more comprehensive bullying prevention program.

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# NATIONAL-LEVEL CURRICULUM DECISION-MAKING IN FINLAND, SINGAPORE, AND THE US

SooBin Jang\*

\* Curriculum, Instruction, and Teacher Education, Michigan State University  
620 Farm Lane Erickson Hall Room 313, East Lansing, MI 48824, USA

Phone: +1 (517) 432-5092

[jangsool@msu.edu](mailto:jangsool@msu.edu)

## ABSTRACT

This paper's purpose is to understand different approaches to the national-level curriculum decision-making by looking at three systems: Finland, Singapore, and the US. Although rhetorical and administrative shifts towards centralization are common to many countries under international testing practices, the structure and function of national-level school curriculum, the composition of actors in centralized agencies, and the driving rationale for education centralization, all vary by country due to their differing administrative structures, and histories, and institutionalized curriculum decision-making practices. Based on literature reviews, this paper compares three different approaches to curriculum centralization by questioning and answering who decides on curricula, and how, in the current international testing and comparison policy context. The three examined cases reveal that in each the justification rationale for curriculum centralization is strikingly similar, and that the influence of traditional curriculum decision-makers weakens, whereas new policy actors arise.

**Keywords:** national-level curriculum decision-making; curriculum centralization

## INTRODUCTION

Curriculum decision-making is an "intricate and skilled social process whereby, individually, and collectively, we identify the questions to which we must respond, establish grounds for deciding on answers, and then choose among the available solutions" (Reid, 1978, P. 43).

Fundamentally, curriculum decisions are a political process defined by uncertainty, practicality and complexity, and which require procedural knowledge and prudent and moral reasoning (Reid, 1978, 1988). They are uncertain in that the grounds for decision are unclear, aims are conflictual, problems relate to unique contexts, and people with diverse interests are affected by the solutions (Reid, 1978). Unavoidable conflictual movements within the deliberation process could be seen as fuel for democratic and vital decision-making which can promote education reform (Frey, 2008). Curriculum decisions also have moral and ethical elements, particularly at the national-level, because they should be 'responsible and justifiable acts with public significance' (Scheffler, 1973, p. 461).

K-12 national-level curricula are at the core of nations' education reforms, thus require national-level decision-making and consensus procedures. Although rhetorical and administrative shifts towards centralization are common in many countries under international testing practices, the structures and functions of national-level school curricula, the composition of actors in centralized agencies, and the driving rationales for education centralization, all vary by countries due to their administrative structures and curriculum decision-making practices. By comparing different countries' national-level curriculum decision-making approaches, this author (Jang) addresses the complexity of the notion of rhetorical and administrative curriculum centralization phenomena.

This paper's primary purpose is to understand three different approaches to national-level curriculum decision-making by comparing three systems, namely Finnish, Singaporean, and US American. Those three cases were chosen because they have significantly distinguishable approaches to national-level curriculum decision-making. Whereas both Finland and Singapore often are mentioned in the comparative education policy arena because of their successful stories and quality national-level curriculum, the US had been left out in national-level curriculum discussions until their recent centralization project of the Common Core State Standards (CCSS). This extended literature review (Jang's) will examine each system and try to discern who are the decision-makers on curricula, and how, in the current international testing and comparison policy context, those decisions are arrived at.

This author begins by reviewing the literature on national-level curriculum decision-making relative to the current notion of administrative and rhetorical centralization in education policy. In the section after that, she examines and compares the three above-identified national-level curriculum decision-making approaches. And in the last section she concludes by discussing the complexity of centralization phenomena in education policy. Why School Curriculum Centralization?

To understand the phenomenon of school curriculum centralization, it is helpful to start with the concept of curriculum control. Curriculum control or governance is often about the allocation of constitutional authority across governmental levels, often framed as centralization versus decentralization, or top-down *versus* bottom-up. Formal institutions and actors at different governmental levels wield power and make curriculum

decisions that influence teaching and learning.

Curriculum control goes beyond the matter of who writes a curriculum. It also relates to the characteristics and purposes of the developed curriculum, along with the degree of legal compulsion it requires (Tanner & Tanner, 2007). Example: writers of national-level or state-level curricula decide the degree of specificity of the document; the more the curriculum developers prescribe, the less the autonomy of schools and teachers (Porter et al., 1990). Also, the more aggressive the central curriculum agencies' motivation is for control of education, the more those developed curricula accompany legal and administrative tools to mandate their aligned implementation (Kirst & Wirt, 2009).

In the previous two decades of education policy contexts, the shift towards strong curriculum control often has come with legal and administrative strategies to hold schools accountable.<sup>i</sup> A common policy maneuver to regulate curriculum implementation is the interweaving of curriculum policies with a testing regime (McDonnell, 2004; Tanner & Tanner, 2007; Porter et al., 1991). And in many countries, education officials increasingly have relied on student testing as a tool for holding schools accountable to *externally* imposed standards (McDonnell, 2004). For example, during the standards movement in the US, many states have revamped their assessment systems so as to align them closely with specific content and performance standards (Tanner & Tanner, 2007; Kirst & Wirt, 2009). This particular curriculum control strategy gains more power in an era of international comparisons and testing (Baker & LeTendre, 2005).

Current national-level education policy-makers in many countries are influenced by the notion of *international testing* and comparisons. International agents diffuse norms, models, and techniques of testing and assessment; those agents include Organisation for Economic Co-operation and Development (OECD), The United Nations Educational, Scientific and Cultural Organization (UNESCO), International Monetary Fund (IMF), and The World Bank. For some countries, the impetus for assessment and testing comes by way of conformist coercion and other pressures but generally, those international organizations can have greater salience than national ones in accounting for the diffusion of educational reforms (Kamens & McNeely, 2010).

The growth of the impact of international testing on domestic policy making is based on the broad notion that education is 'a central requirement for national economic development and political democratization' (Kamens & McNeely, 2010, p.5); and the practices of international benchmarking are means to reach that. Baker and LeTendre (2005) found that international testing often fuels interest in national assessments, and works as stimuli for further cycles of educational reform. Results in international comparisons including The Programme for International Student Assessment (PISA) and The Trends in International Mathematics and Science Study (TIMSS) often associate with national pride and economic competitiveness rhetoric in the contexts of curriculum reform.

Historically, even prior to dissemination of international testing data, arguments existed in domestic education policy contexts that education would help countries be more economically competitive in the global market (McDonnell, 2004; Tanner & Tanner, 2007; Macpherson, 1990; Goodson, 1990). For example, most notably *A Nation at Risk* in 1983 in the US resulted from the 1980-82 recession and fear of increasing global competition, and called for the stronger school curriculum control (Kirst & Wirt, 2009). Echoed by newspapers and media, the perception of national crisis and the need for a national-level curriculum quickly diffused to the public, at least in many western nation-states (Goodson, 1990). These arguments, which assume connections between well-defined standards and assessments and economic competitiveness, easily have been adopted by politicians, business leaders, and education reformers (McDonnell, 2004).

In the preceding three decades, discourses around the 21<sup>st</sup> Century skills- and data-driven educational decisions also have fueled the impact of international testing and comparisons in domestic educational policy-making environments. First, a global interest in the essential 21<sup>st</sup> Century skills - i.e., problem solving, communication, teamwork, technology use, innovation etc. - was witnessed (Trilling & Fadel, 2009; Tapscott, 2009). The view formed that the 21<sup>st</sup> Century is a time of global network of economic, technological, political, social and ecological interconnections, thus it calls for individuals with those common skills from a human-capital perspective (Trilling & Fadel, 2009). Advocates of 21<sup>st</sup> Century skills commonly view education as a means to economic prosperity, exemplified by the label '*golden ticket to a brighter economic future*' (Trilling & Fadel, 2009, p. 73). Within 21<sup>st</sup> Century discourses, education draws attention from other sectors as a means for economic competitiveness, and invites non-traditional policy actors into education decisions (Davis, 2013).

Enhanced attention to data-driven decision-making in public policy is another factor which heightens the impact of international testing in domestic educational policy-making (Marsh et al., 2006; McDonnell & Weatherford, 2013b). Data-driven policy-making requires data to make decisions to act and often calls for additional information for the efficacy of decisions in increasing accountability. In education, achievement test data particularly have become the most prominent elements in accountability policies (Marsh et al., 2006). Implicit in data-driven decision making notions is an assumption that data are neutral and important sources of information to achieve consensus among the public on conflicting education agendas; McDonnell (2004) described testing as "useful policy strategies based on persuasion that diffuses that notion of what constitutes a good education to society with its accompanying link to curriculum standards" (p. 181).

### Case 1: The Finnish System

The Finnish system gives substantial autonomy to local schools and teachers. While Finland's national core curriculum guides local schools and teachers, those teachers still develop a more detailed curriculum for their students (Darling-Hammond, 2010). In the past, before the empowerment of teachers from the late 1970s to the mid-1990s, the national core curriculum documents exceeded 700 pages of prescriptions (Vitikka et al., 2012). However, the current national core curriculum is *much* briefer (approximately 10 pages), guiding teachers in collectively developing local curricula and assessments (Darling-Hammond, 2010). As a result of policymakers' large investment in teachers by policymakers, those teachers have substantial autonomy in planning teaching and learning. That autonomy allow them to continue to try new ideas and methods, and to learn through innovations and inquiry (Sahlberg, 2007). The national core curriculum works as a framework around which local curricula are designed (Vitikka et al., 2012).

In the 1970s, curriculum reforms started by eliminating tracking-based academic ability; a common curriculum was developed throughout the entire system (Darling-Hammond, 2010). However, in those days it was strongly centralized; in the 1985 curriculum reform, Basic Education Act, directions emerged for decentralization and teacher autonomy (Vitikka et al., 2012). In the curriculum reform of 1994, rights of the local municipal authorities were recognized, and they were given more decision-making powers (Vitikka et al., 2012). Example: textbooks and school inspections by centralized agencies were abolished, and school-based decision-making became important (Vitikka et al., 2012). However, the 2004 curriculum reform shifted back to centralization emphasizing national-level decision-making (Vitikka et al., 2012). Moreover, national-level assessment was introduced (Finnish National Board of Education, 2011).

Based on Sahlberg's work (2007, 2009), Darling-Hammond (2010) argued that Finnish practice differs from many other countries' curriculum practice because they are not enforcing curriculum standardization of through frequent external tests, and are not narrowing the curriculum to basic skills in reading and mathematics. Darling-Hammond averred that Finland does not use national assessment as a curriculum-control policy instrument, but uses a centrally-developed assessment of *samples of students* for curriculum improvement purposes, instead of holding schools accountable. In Finland, the national core curriculum document serves two functions: first, as an administrative steering document, and second, as a guiding document for teachers to develop their teaching practice (Vitikka et al., 2012).

The Council of State decides the general goals of education as well as the time allocation for subjects based on the Basic Education Act and decrees (Vitikka et al., 2012). General goals of education and time allocation for subject matters are sensitive critical decisions in designing national-level curricula. The National Board of Education writes the national curriculum (Finnish National Board of Education, 2006) and education providers document their own local curricula. School officials of the municipality approve the curriculum for school-level (Halinen & Järvinen, 2008). Local-decision making reinforces teachers' and local officials' sense of ownership of the curriculum (Halinen & Järvinen, 2008). The sole part not governed by public education agents is textbooks; private publishers translate curriculum documents into education resources (Heinonen, 2005).

Although the process of curriculum development is hierarchical, in two recent reforms (1994, 2004), participants comprised expanded retinues of not only education professionals and parents, but also a broad range of interest groups, such as administrators, unions, education providers, and schools (Vitikka et al., 2012). Vitikka et al. (2012) argues that developing and establishing systems for collaboration is a crucial part of their success; and their procedural knowledge, which makes curricular deliberation possible, is the result of their previous practices. And they have developed ways to invite various players into the deliberation process; for example, the Parliamentary Committee of the Future, includes both private- and public representatives with the key stakeholders of the society, as a way to build consensus (Sahlberg, 2011). In the past, subject-specialist groups mainly participated in developing curriculum, and it was fragmented; however, changing the structure and the function of the national core curriculum document, from a course of study to a normative consensus about education and learning goals, as an agreed-upon written platform for further curricular deliberation, allows creation of a collaborative system (Vitikka et al., 2012). More, the culture of active nongovernmental organizations (as many as 130,000 registered nongovernmental groups or societies) and of each citizen belonging to three associations or societies on average, is ample opportunity to learn social skills, problem solving, and leadership for deliberation (Sahlberg, 2011).

The Finnish National Core Curriculum (2004) is common ground for further deliberation about teaching and learning, and is legitimized by the need for national unity, equity, and the basic rights of education (Vitikka et al., 2012). Ever since Finns reached national consensus on the idea of quality-equal basic education for everyone in the 1970s, these principles have led school reforms and have been restated in national core curriculum documents (Vitikka et al., 2012). The need for quality-equal basic education is strong justification for a centrally-controlled curriculum. In the postwar era, education was the means of social and economic development in Finland, and drew growing interest among the public (Sahlberg, 2011). High societal interest in education set the basis for national-level consensus, and provided a culture of wide deliberation.

From the 1970s to the 1990s, from the business sector and the conservative rightwing, against the

comprehensive schools, came push-back against the quality of equal school reform. Their argument was that egalitarian ideas jeopardize the economy and the prosperity of Finnish society, thus the nation needs to revert to the old streaming and tracking system, allowing a competitive element into the system (Sahlberg, 2011). In 1988 business leaders initiated a survey of the *actual* state of the comprehensive schools, which discerned that the egalitarian system was defeating individual talent by employing a unified curriculum in all classrooms (Sahlberg, 2011). Arguments supporting a more competitive market economy gained more strength with the emerging New Public Management since the PISA study where Finnish students excelled more than most other countries in reading, mathematics and science, those domestic criticisms against comprehensive schools have decreased (Sahlberg, 2011).

Possibilities are available for change in the decision-making structure or the formation of decision-makers in the future. Example: in the mid-1990s the business sector pushed for change in school curricula (Volanen, 2001), driven by the severe economic recession at the beginning of 1993 (Sahlberg, 2011). Nokia, then a leading Finnish company, argued how important it is to highlight creativity, problem-solving, interdisciplinary projects and teaching methods in school curricula (Sahlberg, 2009). Also, echoing the knowledge economy and the 21 st Century skills discourses in many other countries, the arguments that schools should teach practical and higher-order thinking and applicable skills gained power in Finland (Vitikka & Hurmeerinta, 2011).

#### Case 2: The Singaporean System

Singapore is a significant city-state with a population similar to Finland's. However, the Singapore national-level curriculum decision-making system limits individual school and teacher autonomy through a highly-centralized curriculum development process led by the Ministry of Education.

Since the mid-1990s, the Singapore government has been attentive to decentralization. However, school- and cluster-level education practices remained regulated by the Ministry of Education (Tan & Ng, 2007; Gopinathan & Deng, 2006). Tan and Ng (2007) analyzed that Singaporean decentralization, led by a central agency, was initiated primarily for the effectiveness of education governance, not necessarily for promoting teacher autonomy. In other words, decentralization was introduced as another policy control instrument. When these decentralization education reforms reached the school-level, they gave more powers to *principals* in decision-making, rather than to *teachers and students* (Tan & Ng, 2007). The purpose of decentralization reforms was for better management, not for active political and civil participation.

Singaporean centralized education governance aligns with the general government's robust interventionist approach, which supports collectivism propaganda to hold a diverse population together for national advancement (Tan & Ng, 2007). The official vision of Singaporean education, Thinking Schools Learning Nation (TSLN) reform, encourages school-level autonomy to promote project-type learning and higher-order thinking skills; however, those school-level decisions require approval by the Ministry of Education (Tan & Ng, 2007; Tan, 2007). Moreover, National Terminal Examinations still are controlled by the central office, a most-powerful curriculum control strategy (Tan, 2007). For example, although TSLN allows schools to cut away 30% of the mandated curriculum by the central agency, to experiment with school-based creative and critical thinking programs, many teachers use this time to train their students for exams (Vaish, 2014).

The Curriculum Development Institute of Singapore (CDIS), formed in 1981 under aegis of the Ministry of Education - MOE, prescribed primary and lower secondary-level curricula in the 1980s (Vaish, 2014). For upper secondary-level, Singapore used the Cambridge Examination Syndicate (CES) syllabi for the O and A levels, and a per-decade committee was established to examine syllabi in comparison to those used in the United Kingdom (Toh et al., 1996). A high-stakes examination system was also started in the 1980s (Gopinathan & Deng, 2006). In 2004, a curriculum reform was based on recommendations of the Junior College/Upper Secondary Education Review Committee, appointed by MOE - mainly comprising senior MOE officials, tertiary professors, school principals, and experienced classroom teachers (Gopinathan & Deng, 2006). Unlike Finland, the Singaporean curriculum decision-making process is not open to parents, business sector, teacher unions, and non-governmental organizations.

A key function of Singapore's education system is sorting students. Ho (2012) found that the curriculum differs significantly in content for the three main ability groups. Students in three ability tracks determined by academic achievement - i.e., the elite Integrated Program (IP), the mainstream Express and Normal Academic track (E/NA) and the vocational Normal Technical (NT) track, learn different citizenship knowledge; only IP students have the opportunity to learn a rich curriculum in social studies, with alternative forms of assessment such as project work and participation in social action so they can be prepared for future leadership roles. Ho (2012) analyzed that this is due to the ruling party's belief in democratic elitism and its allocation of education resources by merit. When the central education agency has power to place students into different tracks, thereby ultimately determining students' futures, any district-level or school-level decision-making becomes minor. As long as MOE retains authority to sort students by high-stakes assessments, schools, teachers, parents, and students voluntarily will stream themselves into the central agency. The Singapore national-level curriculum is a social cohesion instrument as well. When former Prime Minister Goh Chok Tong launched TSLN in 1997, he introduced National Education (NE) as part of the reform. His rationale was that

young Singaporeans - born after independence - knew little about Singapore's history (Koh, 2006). Speaking with school students, he was appalled at their ignorance of Singapore's history, so immediately established a committee to develop NE (Tai & Chin, 2007), not to be taught as a separate subject but to be infused into social studies, civics, moral education, history, geography, and the "general paper" (Koh, 2006). At *elementary* level, NE's goal is to "Love Singapore"; at *secondary* level, it is to "Know Singapore"; and at *junior-college* level, it is to "Lead Singapore" (Tai & Chin, 2007). Koh (2006) analyzed that the explicit justification of implementing NE was as a response to globalization that may erode the Asian ethos and values of the youth; but that it actually reflects the paradigms of the ruling political party of Singapore and is designed to produce conformist thinking.

The two repeating justifications for strong centralized education authority are social cohesion and economic competitiveness. The social cohesion rationale is due to Singapore's diverse demographics (Tan & Ng, 2006). Regarding economic competitiveness, political agencies have been repeating that Singapore has few natural resources and small land; thus the development of human capital through the national school system is an important mandate of the government (Vaish, 2014; Darling-Hammond, 2010). Economic competitiveness is still the main motivation for education reform in Singapore. Example: TSLN was initiated as a solution to the crisis discourse arising from the Asian economic crisis of the late 1990s, in which East Asian countries suffered severely (Vaish, 2014; Kramer-Dahl, 2004).

#### Case 3: The US American Approach: Common Core State Standards

The highly-localized US education governance system has been moving towards centralization over the last two decades. Technically, there is no national-curriculum in the US, but Common Core State Standards - CCSS, released in 2010 have become *national-level* standards adopted by most states. CCSS is the first national-level school curriculum standards in the US supported by the federal government.

CCSS mainly comprise i) expectations for student knowledge, and ii) skills that should be developed in K-12 in English and math (Porter, et al., 2011). They have different characteristics and purposes than the Finnish and the Singaporean national curricula. In each of the Finnish and Singaporean systems, the national curriculum is the platform, the ideological common ground for their education system, good teaching and learning, and future vision. CCSS, however, is the *content* curriculum: 'Grade placements for specific topics are made on the basis of state- and international comparisons and on the collective experience and collective professional judgment of educators, researchers, and mathematicians' (Common Core State Standards Initiative, 2010, p.5). Given the long tradition of local control and resistance to the idea of national standards in the US, it could have been relatively easier to agree on math and reading content standards because they seem to involve neutral skills, and are the subject areas tested in international comparisons. Developing a national curriculum similar to those in Finland and Singapore requires society-level consensus on highly value-laden ideologies; it is not easy for any big and diverse country with the tradition of strong localism, including the U.S., to reach such consensus.

Leaders of the CCSS initiative were well aware of the messy negotiating and political nature of curricular decision-making, at least in the past, based on personal judgments. By asserting the guiding principle of the development process, driven by evidence and research, they tried to, and to some extent were able to, avoid past ideological debates (McDonnell & Weatherford, 2013). According to McDonnell and Weatherford (2013), there have been more than 25 organizations in promoting and implementing the CCSS; those include the National Governors Association (NGA) and the Council of Chief State School Officers (CCSSO), which represent elected officials. They have worked as *policy entrepreneurs* in developing the CCSS (McDonnell & Weatherford, 2013). Policy entrepreneurs are "advocates ... willing to invest their resources - time, energy, reputation, money - to promote a position in return for anticipated future gain in the form of material, purposive, or solidary benefits" (Kingdon, 1995, p. 179). Others who are not policy entrepreneurs but support CCSS are parents groups, private education providers, foundations, civil rights organizations, and teacher unions (McDonnell & Weatherford, 2013). Developing standards was possible via the organized leadership of CCSSO and NGA. Based on the failure of former administrations to move on national standards, CCSSO and NGA sought to avoid the ideological controversies (McDonnell & Weatherford, 2013). One of their strategies was to promote research and evidence-based policy process (Wilhoit, 2009). Also, they needed to ensure that the CCSS is represented by various interest groups, expressly state officials and classroom teachers. Groups representing those constituencies were consulted regularly and reviewed draft standards (McDonnell & Weatherford, 2013), a successful strategy as evidenced by the American Federation of Teachers (AFT)'s and National Education Association (NEA)'s claim that CCSS reflects the perspective of classroom teachers (McDonnell & Weatherford, 2013).

CCSSO, NGA, and their allies have *kept a visible distance* from the US Department of Education throughout this process, as if they were to carry on the CCSS as a state-led effort (Rothman, 2011). Federal legislators and policymakers were informed about CCSS but stayed out of the initiative (McDonnell & Weatherford, 2013). Unlike Singapore, centralization by demand will face huge resistance, given the long tradition of local control and heterogeneity in the US; national-level curricula in the US needs more persuasion, less ideology, and more scientific (or scientifically sounding) justification, compared to Finland, and Singapore.

A rationale for CCSS advocates, prominently led by two former state governors (North Carolina, West Virginia), was international competitiveness (McDonnell & Weatherford, 2013b). They argued that US student achievement is low compared to global economic competitors' achievements, and that "countries with high-achieving students have focused, rigorous, and coherent national standards" (McDonnell & Weatherford, 2013b, p. 121).

The Bill and Melinda Gates Foundation mostly funded the development of CCSS (McDonnell & Weatherford, 2013), between 2008 and mid-2013 spending over US\$200-million on it and the concept of college- and career-ready standards (McDonnell & Weatherford, 2013). The Foundation also invested in efforts to create collaborative policy networks; the funding sufficiently motivated group members to commit to a long process and to coordinate their work with other unfamiliar or sometimes opposing groups (McDonnell & Weatherford, 2013). McDonnell and Weatherford (2013) found that the Foundation's funding offered time for diverse actors to build trust and to collaborate.

After CCSS was written, the federal government, by packaging the use of high-quality career and college-ready content standards with the competitive grants and the No Child Left Behind (NCLB) waiver, played an important role in dissemination of the CCSS under the Race to the Top – RTTT program. (Wong, 2013). To win grants and the NCLB waiver, states tend to adopt the CCSS as one of their key strategies to raise student performance (Wong, 2013). Jeffrey Henig (2007) viewed the RTTT program as masking rearrangement of authority, which potentially could harm education institutional autonomy, because the way states compete for institutional innovations, and the zero-sum aspect of governance, enhance the power of a central education agency.

### Three Different Approaches to National-level Curriculum Decision-Making

The cases of Finland, Singapore, and the US, reveal that the idea of curriculum centralization may unfold differently depending on their domestic policy environment. Different policy environment - i.e., the context of the constitutional arrangements of jurisdiction, previous related-policy practices, culture and social norms, etc., has huge implications for the style of governance applied to education and to the actors involved in curriculum decision-making (See also, Mintrom & Walley, 2013). Centralized curriculum can be authorized through social elements such as legal status, norms, expertise, and organized advocacy (Spady & Mitchell, 1979). Social elements authorizing national-level curricula vary in all three. Table 1 summarizes key differences between Finnish, Singaporean, and the US American national-level curriculum decision-making approaches, characterized thus: *civic model* (Finland), *authoritarian model* (Singapore), and *policy network model* (US American).

Table 1. Key Characteristics of National-Level Curriculum Decision-Making Approaches

	Finland Civic model	Singapore Authoritarian model	US American Policy network model
Policy Environment	Advanced civic society (Sahlberg, 2011)	Democratic elitism (Ho, 2012)	Tradition of local control (Kirst & Wirt, 2009) Policy entrepreneurship (McDonnell & Weatherford, 2013)
Actors participating in decision-making process	<ul style="list-style-type: none"> <li>• Finnish National Board of Education (Education professionals, parents, administrators, unions, education providers, schools (Vitikka et al., 2012))</li> <li>• <i>Parliamentary Committee for the Future</i> includes private and public representatives (Sahlberg, 2011)</li> </ul>	<ul style="list-style-type: none"> <li>• MOE</li> <li>• Junior College/ Upper Secondary Education Review Committee appointed by MOE (senior MOE officers, tertiary professors, school principals, and experienced classroom teachers) (Gopinathan &amp; Deng, 2006)</li> </ul>	<ul style="list-style-type: none"> <li>• 25-plus organizations include National Governors Association (NGA), Council of Chief State School Officers (CCSSO), representing <i>elected</i> officials</li> <li>• Parents groups</li> <li>• Private education providers</li> <li>• Foundation (The Bill &amp; Melinda Gates Foundation)</li> <li>• Civil rights organizations</li> <li>• Teacher unions (McDonnell &amp; Weatherford, 2013)</li> </ul>

Document formats	Normative consensus about goals of education and learning as a written platform	Ideological platform (including National Education; NE) and a course of study	Specific subjects (English and math) content standards
Official justification for centrally-controlled curriculum	Need for equal basic education	Need for central authority to sort students, and social cohesion	Need for competitiveness in international testing

A prominent characteristic of the Finnish system is the wide range of citizen participants in national-level curriculum-*deliberation*. Finnish national-level curriculum decision-*making* is led by the Finnish National Board of Education, managed by Board directors who represent political decision-making, local authorities, teachers, and social partners.

(*vide* FNBE website [http://www.oph.fi/english/about\\_fnbe/task\\_services\\_and\\_organisation](http://www.oph.fi/english/about_fnbe/task_services_and_organisation)).

Board formation is not limited to traditional education actors (i.e., education experts, administrators, and teachers) but also is open to instances outside education (i.e., parliamentarians) and in the public arena (i.e., business representatives). Members are appointed by the Ministry of Education and Culture. Finnish Core Curriculum then is reviewed outside education-related institutions such as the Parliamentary Committee of the Future, where 17 elected parliamentarians autonomously decide various policies related to the future and serve as a think-tank. According to Sahlberg (2009), Finland’s advanced civil society creates a good environment for effective private and public collaboration.

In the Singapore approach, in contrast, the central office (the Ministry of Education - MOE) has hegemonic power in national-level curriculum decision-making. Not only content standards are regulated strongly by MOE, but also the implementing process, national assessment, teaching and learning approaches, instructional materials, etc ...

(*vide*: MOE website: <https://www.moe.gov.sg/about/org-structure/cpdd>).

As in the case of NE (Tai & Chin, 2007), the Singapore national curriculum is used as an effective political communication tool transmitting collectivistic, social-cohesive, and democratic elitism ideologies by political elites. With their power to sort *elite* students, the MOE (and political elites in central government) easily infuse their values into the national curriculum.<sup>ii</sup> If one’s early success in the education system determines one’s future position in society, submission to national curriculum and to MOE is an inevitable choice for most individuals; either voluntarily or involuntarily, they contribute to the reproduction of those hidden values.

In the US, the CCSS case is unique because of policy entrepreneurship and policy network led by state-level general politicians (NGA) and education philanthropists.<sup>iii</sup> State governors, not necessarily education professionals, established agenda and drew public attention to the need of national-level content standards. The Bill and Melinda Gates Foundation, venture education philanthropists and powerful policy entrepreneurs in the US educational policy context, funded the CCSS project. Unlike Finland and Singapore, the CCSS tried to keep administrative distance from the central government and appealed that the CCSS initiative is *not* an attempt to top-down curriculum control. It was politically important to advertise CCSS as state-led reform, for CCSS to succeed in the US political context. Thus the CCSS case in the US remained as a technically local (state-led) initiative. However, once CCSS was released, many efforts and incentives were made to expand its implementation of to national-level - i.e., the RTTT requirement. Compared to Finland and Singapore, the CCSS project was an *initiative*, shaped by policy entrepreneurs via policy *network* form. In Finland and Singapore, national-level curriculum decision-making process is an established *official* process; however, since CCSS was almost the first national-level curriculum drafting and implementing project in the US, it had an advantage for agenda setting and mobilizing attention and support. By intentionally avoiding official and top-down trajectory and adding grass-root flare, the CCSSO was able to mobilize a wide arrange of supporting organizations.

In Finland and the US, the change in social expectations seemed to place pressure on different sets of individuals and groups to participate in education governance. For example, in the US, a set of new actors, including mayors, state governors, and presidents, seeks to achieve greater control over traditional forms of school governance; this ultimately weakens the influence of traditional curriculum policy actors (Henig, 2013; Allen & Mintrom, 2010). In Finland, push-back from the business sector increased in the 90s until the recent dissemination of international comparison data, used as evidence to support the excellence of their current system.

For both Finland and the US (and, to some extent, Singapore), *democracy* or *participatory* decision-making seem one of the important administrative values in the national-level curriculum decision-making process. In the public policy arena, participatory policy-making has been considered a strong policy instrument of persuasion. Since it appears to be democratic, it reduces the chances of resistance by creating a sense of ownership among citizens (Michels & Graaf, 2010; Papadopoulos & Warin, 2007). This explains why traditional



educational policy actors lose their power to parents' groups, business people, and politicians. However, except for Finland where the national-level core curriculum document leaves substantial autonomy for classroom teachers, their status and their decision-making power in the growing assertion of curriculum centralization is obscure. Given that site-based management arguments assume the expertise and commitment of teachers in curriculum decisions (Porter et al., 1991), teachers and teacher organizations are expected to be a part of *official* curriculum decision-making. In both Singapore and the US, in their official reports classroom teachers were part of the decision making, but were their presence in the process more symbolic than actual? Participatory policy making can be mere formality, creating a false sense of ownership among citizens, and giving ways for government (and leading policy groups) to be blameless (Michels & Graaf, 2010).

Deciding what to be taught in public school classroom is a value-laden *public* issue. Regardless of the level of curriculum decisions, from school-level to national-level curricula, curriculum design is the outcome of dynamic, political, collective, and not-yet-completed justification interactions among curriculum decision makers (Walker, 1971). In complex and heterogeneous contemporary society, building a national-level consensus on the matter of school curricula is becoming more difficult for a *single* organization. As the case of the CCSS shows, to initiate national-level curriculum that gains nation-wide support, policymaking arrangements should go beyond traditional hierarchical institutional arrangement. Moreover, the CCSS case suggests ways to avoid ideological conflicts by limiting decisions to specific subject-content standards and excluding the ideological foundation of national education that has the potential to become messy.<sup>iv</sup>

In Singapore, strong institutional authority is still empirical, top-down, curriculum control strategy; the MOE achieves compliance through demand. However, in many other countries, including Finland and the US, increasing diversity and public demand for transparency and accountability in government decisions make Singaporean hierarchical governance less feasible. In particular, transmitting ideological values via mandated national curricula - i.e., NE in Singapore - could be criticized as a form of state indoctrination. For example "Love one's country" (the NE standard) could mean different things for different people with different perspectives.<sup>v</sup> Since curriculum decisions are ultimately the choice of preference and value judgement, it will become even harder to reach national-level consensus on highly controversial ideologies in the future.

Along with democracy or participatory decision-making, *efficiency* is another essential administrative value in the national-level curriculum decision-making process. In education administration history, policy beliefs about strong curriculum control have been picked up by diverse policy actors as means to standardize practice and to increase the efficiency of the education system (Porter et al., 1990). Example: an important CCSS rationale was state-to-state variability and substantial redundancy in previous state standards (Porter et al., 2011; National Research Council, 2008). Achieving high quality of public education through building individual teacher and school capacity requires much time and effort. Since the present demand for public education system is that it ensures suitable quality available for as many students as possible (Mintrom & Wally, 2013), *efficiency* becomes even more important.

Regardless the increase in diversity and difficulty in reaching national-level consensus in contemporary society, the language of performance is a universally accepted principle in administration and public policy. In all three approaches, the dissemination of international testing data as educational performance is fueling justification of curriculum centralization. The language of performance and international comparison repeats traditional nation-building discourse.<sup>vi</sup> That discourse often is associated with psychological aspects, such as fear; for example, the intensity of the discourse increased in the time of the Cold War, the Nation at Risk, and recession (Kirst & Wirt, 2009). Goodson (1990) analyzed that the sequence followed by the crisis rhetoric is strikingly similar among many nation-states. With global economic recession and intense international comparisons, the platform for national-level curricula deliberations is narrowing, and an education goal that does not feed economic competitiveness has difficulty in finding strong support. The impact of dissemination of international comparison data regarding curriculum centralization policy is strikingly similar in all three instances and it signals a chance of streaming effect among cross-national curriculum contents.

#### Conclusion

This paper tried to analyze the national-level curriculum deliberation process by looking at whom will decide on curricula and what justification rationales are deployed in the process. This author specifically examined Finland, Singapore, and US America case. Those three show that curriculum centralization can unfold in widely-differing ways due to each country's policy environment. However, the dominance of the language of performance and the dissemination of international comparison data fuel curriculum centralization in all three.

The question of whom will decide on curricula receives continuing discussion and debate throughout curricular history. Answers to this are that they have been certain to change over time. According to theory (Plank & Boyd, 1994), the shift in authority originates in dissatisfaction or distrust with prevailing institutional arrangements; the distrust of the commitment or capacity of local school boards to increase academic standards underlies the shift of authority from local to state, and from the state to the national-level. However, this does not necessarily mean that new authority has verified commitment or capacity to increase student performance.

#### End Notes

<sup>1</sup> In contrast to curriculum centralization, a line of research and practice around school-based curriculum - or curriculum *decentralization* – has emerged in the 1980s and 1990s. Discourses and efforts around school-based curriculum development often associate with *empowerment* of local schools. Curriculum centralization in this paper does not necessarily add the concept of empowering local schools. For example, in the Finland case, extensive autonomy is given to local- and school- level actors. Finland achieves its high-quality school curriculum by active division of roles; while central government sets the platform of national education, policy efforts to improve the status, capacity, and power of teachers.

<sup>2</sup> While Finnish core curriculum emphasizes the values of learning, Singapore national curriculum stresses students' identities as Singaporean. The Finnish national-level curricula document is a brief item including the objectives and core contents of different subjects, the principles of student assessment, special-needs education, student welfare and educational guidance, and written platform and framework for local schools and classroom teachers as they draw their own curricula.

<sup>3</sup> Compared to traditional philanthropists, the new generation *education* philanthropists try to fix social problem from their *roots*: diagnose the social problem, and actively decide where and how to fund, to solve the social problem. In this way, these recent education philanthropists are active in agenda-setting, mobilizing public attention, and shaping policy and political environment. Examples: The Broad Education Foundation, the Bill and Melinda Gates Foundation, the Walton Family Foundation, the Michael and Susan Dell Foundation, the Donald and Doris Fisher Fund, the Lynde and Harry Bradley Foundation, etc.

<sup>4</sup> Curriculum decision cannot be scientific or value-neutral; it is the choice of *preference*. So, the most crucial part in curriculum decision-making is to rearrange ideological and interest conflicts.

<sup>5</sup> Problems of different views or interpretations were apparent even with content-standards decision-making. In the case of CCSS, one member of the validation committee reported, the validation committee, 17 university faculty and 6 other working researchers, knew there *cannot* be sufficient evidence for any of the standards, and that it is a matter of including and involving feedback from multiple different perspectives (McDonnell & Weatherford, 2013). The validation committee proved that the CCSS based its knowledge on the standards-writers' *previous* works and reputations, and 'on their knowledge of current state standards and international standards and their beliefs that CCSS are better' (McDonnell & Weatherford, 2013, p. 19).

<sup>6</sup> From 19th Century Europe, where France and Germany used the nationalism rationale to implement centralized education systems (Pang, 2004; Satoru, 1990; Lee, 2001; Yoon, 1995), to East Asian countries with highly-centralized systems and patronizing discourse that have experienced successful political and economic development in the late 20th Century (Yoon, 1995), the nation-building justification of education systems has existed for a long time.

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## SELF-EFFICACY BELIEFS OF PROSPECTIVE TEACHERS\*

Sevim Sevgi<sup>1</sup>, Gülsüm Gök<sup>1</sup> and Fulya Öner Armağan<sup>1</sup>

<sup>1</sup>Elementary Education, Erciyes University, Kayseri, Turkey

For correspondence: onerf@erciyes.edu.tr

### ABSTRACT

The purpose of the study is to examine the prospective teachers' self-efficacy beliefs about teaching. Teachers' Sense of Efficacy Scale (TSES) (Tschannen-Moran and Hoy, 2001) with demographic part was administered to prospective teachers at the first and last years at a state university in Turkey. TSES was adapted to Turkish language by Çapa, Çakıroğlu & Sarıkaya (2005). Their study confirmed that three sub-scales of TSES is valid for Turkish prospective teachers. The sub-scales of the TSES: efficacy of instructional strategies and efficacy of classroom management strategies and efficacy of student engagement. In the present study, 213 freshman and 240 senior prospective elementary teachers' data was analyzed by independent sample t-tests. Means of efficacy sub-scales of freshmen are  $M_{\text{instructional}} = 6.80$ ,  $M_{\text{management}} = 6.84$  and  $M_{\text{engagement}} = 6.72$ . Means of efficacy sub-scales of seniors are  $M_{\text{instructional}} = 6.73$ ,  $M_{\text{management}} = 6.73$  and  $M_{\text{engagement}} = 6.59$ . Based on means, Turkish prospective teachers' efficacy beliefs were high. There was no significant mean difference between freshman and senior prospective teachers with respect to their efficacy beliefs in student engagement ( $t(485) = 1.37$ ,  $p = .169$ ), instructional strategies ( $t(471.497) = 0.726$ ,  $p = .486$ ), and classroom management ( $t(472.451) = 1.119$ ,  $p = .264$ ). Implications for further research were given.

**Key words:** self-efficacy, prospective teachers

### INTRODUCTION

The contribution of individual's self-perception to the academic success has been being object of interest of several research. A growing body of that research focused on the 'self-efficacy' component which is defined by Bandura (1997) as beliefs in terms of existing ability to accomplish a task. Self-efficacy was reported as a significant factor that shapes thinking and behavior and influences individuals' course of action towards a specific task (Bandura, 1993; Bandura & Schunk, 1981; Bong, 2004; Chemers, Hu & Garcia, 2001; Smith, Sinclair & Chapman, 2001). Thus, considering the self-efficacy of a teacher towards teaching was appeared to be important for the quality of education. In the scope of Bandura's theory, teacher self-efficacy is defined as a teacher's own "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran & Woolfolk Hoy, 2001, p.783). Briefly, teacher self-efficacy is their perception on their own teaching.

Teachers' efficacy beliefs has been shown to be a significant construct with respect to teaching behaviors and student outcomes (Ashton & Webb, 1986; Tschannen-Moran et al. 1998) such as achievement (Ross, 1992) and self-regulation (Stuart, 2006). Moreover, teacher with high level of efficacy are more open to use student centered methods in the class (Czerniak & Schriver, 1994), to create a positive atmosphere (Ashton & Webb, 1986; Goddard et al., 2004), to reveal more enthusiasm and put more effort on teaching (Allinder, 1994), in turn, which shapes progressive student outcomes (Dorman, 2001; Fraser & Walberg, 1991; Haertel et al. 1981).

Richardson (1996) proposes that prospective teachers develop self-efficacy beliefs towards their potential previously entering teaching profession. Considering them as the future teachers, investigating prospective teachers' efficacy beliefs towards their own capability may reflect their upcoming performance in the field. The research conducted with prospective teachers reported that the participants reflected high teaching self-efficacy (Gencer & Çakıroğlu, 2005) while this may change during their practicing years (Kim & Cho, 2014).

The literature review in the following paragraphs will highlight the theoretical framework on self-efficacy and research focusing on teacher self-efficacy and prospective teachers.

### Literature Review

#### Self-efficacy

Bandura describes self-efficacy as "People's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). More generally, it refers to individuals' own confidence to attain within a specific task. This component is highly related with behavior since stronger efficacy beliefs promote the effort and persistence towards the task (Pintrich & Shunk, 2002; Linnenbrink & Pintrich, 2003). Development of strong efficacy beliefs depends on various constructs. Bandura (1986) identifies four sources of efficacy as mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states. That is, individuals build efficacy beliefs through their own successful

\* This study was presented as an oral presentation at the International Conference on Contemporary Issues in Education (ICCIE 2016), 27-29 May 2016, Zagreb, Croatia.

experiences on the task as well as the successful experiences observed from social models who seen as in similar position. Additionally, efficacy beliefs can be developed by receiving feedbacks from others about their capability on mastering the task and the individual's physiological and emotional response on the task (Bandura, 1977). It is evident from research that people with a high sense of self-efficacy tend to take more challenging tasks (Bandura, 1993; Bandura & Schunk, 1981), to be more persistent on obstacles (Bandura & Schunk, 1981; Schunk, 1982, 1983), to set higher goal challenges (Walker & Greene, 2009; Bandura, Barbaranelli, Caprara & Pastorelli, 2001), to develop deeper interest, higher engagement and motivation on the task. (Bong, 2004; Chemers, Hu & Garcia, 2001; Smith, Sinclair & Chapman, 2001).

### **Teacher Self-efficacy**

Drawing on the work of Bandura, Tschannen Moran et al. (1998, p.233) explains teacher's sense of efficacy beliefs as "teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context." Three types of teaching efficacy identified as efficacy for instructional strategies, efficacy for classroom management, and efficacy for student engagement (Tschannen-Moran & Woolfolk Hoy, 2001). Efficacy for instructional strategies refers to teachers' beliefs in their capability to use several instructional strategies and efficient teaching activities. Efficacy for classroom management focuses on teacher's judgments on ability and skills that required to maintain the classroom order. Efficacy for student engagement means the level of confidence on effectively engaging students and providing engagement in the class.

Tschannen-Moran, et al. (1998) propose a cyclic nature of teacher efficacy that higher efficacy shapes better performance and persistence which in turn brings higher efficacy while the lower efficacy decreases the teaching outcomes ending up with forming low efficacy beliefs. The critical point is that, the teaching self-efficacy beliefs refers to teacher's perception of ability regarding teaching instead of his or her substantial ability. It is the perception of competence instead of actual level of competence. People may misjudge their capability as overvalue and undervalue the potential which may influence extend of effort they put forth and determination they express on struggles.

Research have consistently revealed the contribution of teacher efficacy on their courses of action in teaching process. In the review study conducted by Ross (1994, 1998) six teacher behaviors revealing teacher efficacy was emerged as: "(1) learn and use new approaches and strategies for teaching, (2) use management techniques that enhance student autonomy and diminish student control, (3) provide special assistance to low achieving students, (4) build students' self-perceptions of their academic skills, (5) set attainable goals, and (6) persist in the face of student failure" (as cited in Woolfolk Hoy & Spero, 2005, p.345). Besides, the empirical studies supported the relation between teaching efficacy and these behaviors. Firstly, it is reported that the teacher efficacy beliefs effects their job satisfaction (Caprara et al., 2010; Goddard et al., 2004), enjoyment for teaching (Allinder, 1994; Watters & Ginns, 1995) and constancy to the profession (Coladerci, 1992). Furthermore, teacher with a high sense of efficacy was found to be more persistent with obstacles (Gibson & Dembo, 1984), to reveal more enthusiasm and put more effort on teaching (Allinder, 1994; Milnet & Woolfolk, 2003). In terms of classroom atmosphere, high self-efficacious teachers tend to be more open to innovations (Haney, Czerniak & Lumpe, 1996; Tschannen-Moran, et al., 1998), to use student-centered methods (Czerniak & Schriver, 1994), to be more confident in planning and organizing activities (Milnet & Woolfolk, 2003) to create a humanistic environment (Goddard et al., 2004; Henson, 2001), and to use effective classroom management strategies (Emmer & Hickman, 1991; Henson, 2001; Tsouloupas et al., 2010). These favorable teaching behaviors may lead better student outcomes (Dorman, 2001; Fraser & Walberg, 1991; Caprara et al. 2006).

### **Prospective Teachers' Self-efficacy**

In the perspective of prospective teachers, identification and development of strong efficacy beliefs towards teaching is highly significant considering their future role in the teaching profession. Prospective teachers' own judgements about their capabilities on teaching may express an idea about the courses of action that they will possess when they enter the field since the beliefs are persistent to change (Yalcin, 2011; Bandura, 1997). It is reasonable to expect commitment to the profession of teachers when they develop greater beliefs about their perceived capability in their early experiences such as preservice years (Pendergast, Garvis, Keogh, 2011). On the other hand, teacher efficacy beliefs may change from pre-service to in-service periods since the possible difference between estimation of the abilities and the experience in the reality (Hoy & Spero, 2005). Pre-service teachers may overestimate their competence while this sense decreases when they enter the profession and realize the hardness of teaching or experience negative practices (Weinstein, 1988; Kim & Cho, 2014). Actually, national research on the prospective teachers' teaching self-efficacy generally reveals positive and strong beliefs towards teaching (Tekkaya, Cakiroglu, & Ozkan, 2004; Gencer & Cakiroglu, 2005; Kahraman et al., 2014; Yilmaz & Cavas, 2008) while the studies investigating the change over time had shown mixed results. For example, Hoy

and Spero (2005) reported an increase in pre-service years while they explained a decrease in first year of profession. On the other hand, some of the studies conducted in Turkey reported no significant mean difference in pre-service teachers' self-efficacy in terms of the grade level (Kahraman, Yılmaz, Bayrak, Güneş, 2014; Gencer&Çakiroğlu, 2005). As it is elaborated, to study pre-service teachers' teaching self-efficacy is important to have an idea about their preparations for teaching in the future.

## **METHODOLOGY**

### **Sample**

Teachers' Sense of Efficacy Scale (TSES) (Tschannen-Moran and Hoy, 2001) with demographic part was administered to freshman and senior prospective teachers at a state university in Kayseri, Turkey (N=487, n=253 freshman, n=234 senior). Convenience sampling was used in sampling procedure since researchers were faculty members at the same university. The university is a big university settled down 3 campuses with 18 faculties and 3 institutes located at the Central Anatolia. Prospective elementary teachers are educated through four-year undergraduate programs. These programs at the elementary education department as mathematics teaching, science teaching, social science teaching and foreign language teaching, elementary teaching, and literature teaching.

### **Instrument**

Teachers' Sense of Efficacy Scale (TSES) which was developed by Tschannen-Moran & Woolfolk Hoy (2001) was used to measure prospective teachers' self-efficacy beliefs. This questionnaire consists of 24 items. Each item has 9-point Likert scale as 1—Nothing, 3—Very Little, 5—Some Influence, 7—Quite a Bit, and 9—A Great Deal. The reliabilities for the full scale have ranged from .92 to .95, and for the subscales from .86 to .90 (Tschannen-Moran, Hoy, 2001).

The TSES was translated and adapted into Turkish by Çapa et al. (2005) and named as TTSES. As in the original scale, the Turkish version has three sub-dimensions which are efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management. They reported that the coefficient alpha values of each subscale for the Turkish prospective teachers were .82, .86, and .84, respectively. For the whole scale, the reported reliability was .93.

Sub-scale scores were computed based on the items. Each sub-scale has eight items and distributions of items to sub-scales are as: items 1, 2, 4, 6, 9, 12, 14, 22 for efficacy in student engagement, items 7, 10, 11, 17, 18, 20, 23, 24 for efficacy in instructional strategies and items 3, 5, 8, 13, 15, 16, 19, 21 for efficacy in classroom management. Sample item for efficacy of instructional strategies is as: "To what extent can you provide an alternative explanation or example when students are confused?", for efficacy for classroom management is as: "How much can you do to control disruptive behavior in the classroom?" and for efficacy for Student Engagement is as: "How much can you do to motivate students who show low interest in schoolwork?". In the present study, the Cronbach's alpha for all items of TTSES is .92 while .84 for efficacy in student engagement, .77 for efficacy in instructional strategies, and .85 for efficacy in classroom management.

### **Analysis**

The data collected from the TTSES are then analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. Descriptive statistics is used to describe demographic information and involves the mean, median, mode and standard deviation, while independent samples t-test is used to determine the differences between the groups.

## **RESULTS**

An independent samples *t* test was conducted to evaluate mean differences between efficacy for student engagement, efficacy for classroom management and efficacy for instructional strategies.

Descriptive results as seen at the Table 1 show that the freshman prospective teachers' efficacy sub-scales levels are higher than the senior prospective teachers' efficacy sub-scales levels.



Table 1 Descriptives of the prospective teachers' efficacy sub-scales

	Class	N	Mean	Std. Deviation	Std. Error Mean
Efficacy for Student Engagement	1	253	6.72	1.09	.06
	4	234	6.59	1.02	.06
Efficacy for Instructional Strategies	1	247	6.80	1.18	.07
	4	234	6.73	.98	.06
Efficacy for Classroom Management	1	250	6.84	1.15	.07
	4	225	6.73	1.00	.06

The independent samples *t*-test results (Table 2) show that there is no significant mean difference between freshman and senior prospective elementary teachers in any sub-scales of efficacy levels. The independent sample *t*-test was conducted to evaluate the mean difference of efficacy for student engagement between freshman and senior prospective elementary teachers. The independent sample *t*-test was not significant,  $t(485) = 1.378$ ,  $p = .169$ . Freshman prospective elementary teachers' efficacy for student engagement ( $M = 6.72$ ,  $SD = 1.09$ ) is appeared to be higher than senior prospective elementary teachers' efficacy for student engagement ( $M = 6.59$ ,  $SD = 1.02$ ) but this difference is not meaningful. The 95% confidence interval for the difference in means was ranging from  $-.056$  to  $0.322$  which is quite narrow. The eta square index,  $\eta^2$ , indicated that 0.3% of the variance of the efficacy of student engagement was accounted for whether a student was a freshman or a senior. Another the *t*-test was conducted to evaluate the mean difference of efficacy for instructional strategies between freshman and senior prospective elementary teachers. The analysis reflected no significant mean difference between groups,  $t(471.497) = 0.726$ ,  $p = .486$ . Freshman prospective elementary teachers' efficacy for instructional strategies ( $M = 6.80$ ,  $SD = 1.18$ ) is very close to senior prospective elementary teachers' efficacy for instructional strategies ( $M = 6.73$ ,  $SD = .98$ ). The 95% confidence interval for the difference in means was ranging from  $-.122$  to  $0.266$  which is quite narrow. The eta square index,  $\eta^2$ , indicated that 0.1% of the variance of the efficacy of instructional strategies was accounted for whether a student was a freshman or a senior grade.

Similarly, a *t*-test was conducted to evaluate the mean difference of efficacy for classroom management between freshman and senior prospective elementary teachers. The independent sample *t*-test result showed that there was no significant mean difference between groups,  $t(472.451) = 1.119$ ,  $p = .264$ . Freshman prospective elementary teachers' efficacy for classroom management ( $M = 6.80$ ,  $SD = 1.18$ ) is a little bit higher than senior prospective elementary teachers' efficacy for classroom management ( $M = 6.84$ ,  $SD = 1.15$ ). The 95% confidence interval for the difference in means was ranging from  $-.083$  to  $.305$ . The eta square index,  $\eta^2$ , indicated that 0.2% of the variance of the efficacy of instructional strategies was accounted for whether a student was a freshman or senior.

Table 2 Independent sample *t*-test analysis for prospective teachers' efficacy sub-scales

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Efficacy for Student engagement	Equal variances assumed	.954	.329	1.378	485	.169	.13	.09	-.056	.322
Efficacy for Instructional strategies	Equal variances not assumed	4.486	.035	.726	471.497	.468	.07	.09	-.122	.266
Efficacy for classroom management	Equal variances not assumed	4.704	.031	1.119	472.451	.264	.11	.09	-.083	.305

## DISCUSSION & CONCLUSION

The present study was conducted in order to determine prospective elementary teachers' efficacy for student engagement, efficacy for classroom management and efficacy for instructional strategies and to investigate whether there is a significant mean difference based on their grade levels. Descriptive analyses showed that the freshman prospective teachers' efficacy sub-scales levels are higher than the senior prospective teachers' efficacy sub-scales levels. This higher scores of their efficacy sub-scales levels are not expected. The reason for the increase in freshmen's self-efficacy beliefs may be due to the fact that prospective teachers who entered the teacher education program were feel that they are a superman who change everything in favorable for students. This higher means were not statistically significantly different for freshman and senior groups in all subscales of TTSES. In fact, education level is a significant factor in determining one's efficacy beliefs, (Durdukoca, 2010; UluçınarSağır&Aslan, 2009). There are different study results in the literature, some of the studies reported that there is no significant mean difference in pre-service teachers' self-efficacy beliefs in terms of the grade level (Aydın &Boz, 2010; Kahraman, Yılmaz, Bayrak&Güneş, 2014; Gencer&Çakıroğlu, 2005). On the other hand, it was found that senior students' scores on self-efficacy beliefs were higher than those of the freshman students while this difference was reported to be not statistically significant (Durdukoca, 2010; Uluçınar,Sağır& Aslan, 2009). It can be due to the teaching experience course taken at the last year of the program. Taking teaching experience course may provide more experimentation and observation to prospective teachers. Also this experience course may provide real experience situation related to teaching in real classroom context to prospective teachers.

In many studies, teacher self-efficacy has been found to be consistently related to teachers' classroom management approaches (Henson, 2001; Savran&Çakıroğlu, 2003, Tsouloupas et al., 2010; Tschannen-Moran & Hoy, 2007). Results of the present study showed that there is no significant mean differences between the freshman and the senior prospective teachers regarding self-efficacy beliefs for classroom management approaches. However, freshman prospective elementary teachers' efficacy for classroom management strategies is higher than senior prospective elementary teachers' efficacy for classroom management strategies. It is a particular result comparing to previous results that the senior students were in-expert teachers who had completed their practice teaching experience, while the freshman students had not started their practice teaching experience, yet. The fact that, the freshman prospective elementary teachers'being more optimistic may be a reason for them to have more efficacy beliefs.

Teachers' self-efficacy has been found consistently related to teachers' efficacy for instructional strategies (Kahraman, Yılmaz, Bayrak, Güneş, 2014; Gencer&Çakıroğlu, 2005). According to results of the present study,

there is no significant differences between the freshman and senior prospective teachers regarding self-efficacy beliefs for instructional strategies. Moreover, freshman prospective elementary teachers' efficacy for instructional strategies is appeared to be very close to senior prospective elementary teachers' efficacy for instructional strategies.

Teachers' with high level of efficacy are more open to use student centered methods in the classroom (Czerniak&Schriver, 1994). Moreover, teacher self-efficacy has been found consistently related to teachers' efficacy for student engagement (Czerniak&Schriver, 1994; Rodríguez, Fernández, Pena, Aguin, & Menéndez, 2014). In the results of this study, there is no significant difference between the freshman and the senior prospective teachers regarding self-efficacy beliefs for student engagement. However, freshman prospective elementary teachers' efficacy for instructional strategies is higher than senior prospective elementary teachers' efficacy for student engagement. Therefore, as stated in the previous studies, teachers' overestimation of their own ability may decrease over time especially after experiencing real teaching situations (Hoy &Spero, 2005).

### Limitations

1. The study is limited to data collected from 213 freshman and 240 senior prospective elementary teachers studying in one university, whereas there are 77 elementary teaching departments in different universities in Turkey. Hence, it cannot be generalized to all elementary teaching programs in Turkey but it might give a different perspective from a specific study to other universities and prospective teachers.
2. Second limitation of the study was based on the quantitative data collected through a survey which is structured. Therefore, the study was limited to the items on the survey.

### Further Research

1. Survey might be administered at the beginning of the semester and at the end of the each semester to examine the differences in efficacy levels longitudinally.
2. Different instruments can be applied to the prospective elementary teachers in order to evaluate their self-efficacy.
3. Further research might be carried out with more detailed way such as obtaining data from more universities or making interviews with prospective elementary teachers. Interview results may provide a confirmation and more detailed information on their perceptions.
4. Longitudinal studies might be carried out to reveal how prospective teachers' efficacy beliefs develop or change throughout the years from beginning to the end of their undergraduate education as well as on their practicing years.

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# TEACHER EFFECTIVENESS AND RELATED CHARACTERISTICS: A SYSTEMATIC REVIEW

Dr Rupnar Dutta

Assistant Professor, Gandhi Centenary College, Kolkata, India

Dr Santoshi Halder

Associate Professor, Department of Education, University of Calcutta, India

Prof Malay Kumar Sen

Department of Education, University of Calcutta, India

santoshi\_halder@yahoo.com

## ABSTRACT:

During last two decades, numerous researchers have been studying related characteristics of Teacher Effectiveness. In order to arrive at and identify the research gap on the area of the proposed study, a systematic review of related literature was conducted on '*Teacher Effectiveness and its related characteristics*'. For systematic review, certain definite steps were followed to survey the related literature. First, in planning stage, '*Inclusion and Exclusion Criteria*' were defined to identify the related literature systematically. Secondly, in the review stage, '*Summary of the Findings*' were analyzed and discussed after recording the identified studies in a '*Systematic Review Table*'. Thirdly, in the final stage, '*Research Gap*' was identified in the field of present investigation. Only those studies which were published between the years of 1990 to 2015, were included. For searching the related literature, only the computer based online Internet searches were conducted through the *Search Engines* mentioned above (see Table 1). Only the studies which performed *Survey type* researches with *large samples* based on *Person related* and *Categorical variables*, were included and identified for systematic review. By searching with several permutations and combinations of the *Key words* through the Search Engines, related 244 studies were collected. With respect to the criteria 116 studies were excluded and finally 128 studies were selected and gathered in the pool of systematic table (see Table 2).

## INTRODUCTION

Education is a process of bringing or moulding a young for living a congenial and comfortable life. The ultimate goal of education is the harmonious and progressive development of a child. Educating someone or helping somebody to learn something by providing required information is teaching. According to Radhakrishnan Commission (1948-49), in a society teachers' place is of paramount importance because from generation to generation, he helps to keep the lamp of civilization burning. Indian Education commission (1964-66) has pertinently remarked that teacher is the most important factor to influence the quality of education. The report of International Commission on Education (1996) chaired by Jacques Delors, explored the 'Four Pillars of Education' and stated that in education no reform could succeed without the co-operation and active participation of teachers. The Secondary Education Commission (1952-53) has rightly said that teachers' place is very important both to the school as well as to the society with respect to their personal qualities, educational qualifications and professional training. In the version of American Commission on Teacher Education (1946), the quality of a nation depends on its citizens' quality which actually depends on the quality of the teachers of that nation. According to the database of District Information System for Education (DISE, 2013-14), jointly developed by National University of Educational Planning and Administration (NUEPA), Ministry of Human Resource Development, Government of India and United Nations International Children's Emergency Fund (UNICEF), in India, around 1.4 million teachers are engaged in providing secondary education where the teacher-student ratio is 1:25, whereas in case of West Bengal, a state of India, around 87,672 regular teachers are imparting secondary education where the teacher-student ratio is 1:28. So, the quality of these teachers is extremely important to the quality of this nation as well as to the state of West Bengal.

Improving teacher quality through enhancing Teacher Effectiveness has been the major issue to the researchers, educationists and policy makers all over the World for educational reforms during the last 50 years. Effectiveness of individual classroom teacher is the single largest factor affecting academic growth of the students (Ferguson, 1991; Goldhaber, 2007; Kennedy, 2010; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). A growing number of studies are focusing on the effects of teachers' training on effectiveness of the teachers (Cochran-Smith & Zeichner, 2005; Darling-Hammond, 2000; Konold et al., 2008). Teachers' Training Programmes (TTP) or Teacher Preparation Programmes (TPP) are an obvious potential source of variability in Teacher Effectiveness (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Farooq & Shahzadi, 2006; Gansle, Noell, & Burns, 2012). Almost all the education Commissions and Committees argued for the proper teacher training to develop the quality of education in India (Reports of the Education Commission, 1964-66; National

Policy of Education, 1986; Secondary Education Commission, 1952-53). National Council for Teacher Education (NCTE), a statutory body of the Govt. of India, strongly argued for the quality development of the teacher education programme in India to produce good and effective teachers. But, the key question is, if most trained teachers are effective, does it matter that a small percentage of them are less effective? It really matters a lot because a teacher with less effectiveness can depress the achievement and inhibits the learning of a large number of students over time depending on the school capacity, class size and his service life (Chait, 2010; Kodero, Misigo, Owino, & Simiyu, 2011). Indian Education Commission (1964-66) also acknowledged the effectiveness of teachers and their characteristics regarding the learning and achievement of the students. The related characteristics of the effective teachers are undoubtedly the most significant aspects which actually influence the effectiveness and quality of every teacher and thus also have large contributions to the quality development of education and to the national development.

### **Teacher Effectiveness and Teaching-learning Process**

In recent years an enormous amount of public attention has been focused on teacher quality and teacher preparation (Cochran-Smith, 2006). These initiatives have listed the effectiveness of teachers as a major factor in improving student achievement (Brewer, 2006). Effective instruction meets the demands of the students with respect to the academic disciplines of the teachers i.e., their subjects of teaching. The effectiveness of teachers and teaching are most significant in determining the learning of students (Ferguson, 1991; Ingersoll, 2004; Sanders, 1998). Teacher Effectiveness is vital for improving student learning and achievement (Darling-Hammond, 2000; Hanushek & Rivkin, 2004; Hanushek, Kain, O'Brien, & Rivkin, 2005; Rivkin et al., 2005). Researches support that the actions taken by the effective teachers in the classroom play a fundamental role in effective and efficient learning of the students (Andrew & Schwab, 1995; Markley, 2004; Wang & Fwu, 2007). Students' academic achievement and outcomes depend on the effectiveness of their teachers (Campbell, Kyriakides, Muijse, & Robinson, 2004; Lasley, Siedentop, & Yinger, 2006; Rockoff, 2004). Teachers' quality and effectiveness may depend on their content knowledge and pedagogical acumen (Berry, O'Bryan, & Cummings, 2004; Liakopoulou, 2011; Sadler, Sonnert, Coyle, Smith, & Miller, 2013). Some researchers also argued that teachers' quality and effectiveness should be assessed only by student outcomes, regardless of content knowledge or pedagogy (Stronge, Ward, Tucker, Hindman, McColsky, & Ioward, 2007). In fact, effectiveness and quality of the teachers are extremely complex and illustrate various characteristics like wide range of knowledge, skills, aptitude, motivation and personality characteristics (Mitchell Robinson, Plake, & Knowles, 2001).

### **Assessing Teacher Effectiveness**

Effectiveness of the teachers is often measured by the student achievement (Darling-Hammond, 2000; Kupermintz, 2003; Sanders, 1998). By using Value Added Models (VAM) and analyzing value-added student achievement data some researchers found that teachers' influence on the achievement gains of the students' was maximum than any other factors (Goldhaber & Anthony, 2003; Sanders & Horn, 1994; Sanders & Rivers, 1996; Wright, Horn, & Sanders, 1997). Though, few researchers not agreed to this view because according to them teachers did more than simply raising test score gains of the students (Loeb, Rouse, & Shorris, 2007). Student achievement is just a measure of one educational outcome but does not measure teachers' characteristics i.e., Teacher Aptitude, attitude of the teachers, Work Motivation, Personality Traits etc. Measurement of Teacher Effectiveness become problematic due to the difficulties in measuring students' performance, gains and loses with respect to an individual teacher with the passage of time (Imig & Imig, 2006; Loeb et al., 2007). Other ways to assess Teacher Effectiveness except collecting student achievement data are to collect teacher ratings from multiple sources e.g. Students' ratings (Emery, Kramer, & Tian, 2003; Seldin, 1999), Colleague ratings (Berk, Naumann, & Appling, 2004; Webb & McEnerney, 1995), Alumni ratings (Hamilton, Smith, Heady, & Carson, 1997; Kulik, 2001), Employer and Administrator ratings (Diamond, 2004; Seppanen, 1995), Head Teacher ratings (Brandt, Mathers, Oliva, Brown-Sims, & Hess, 2007; Heneman, Milanowski, Kimball, & Odden, 2006; Okolocha, & Onyeneke, 2013) and Self-evaluation or Self rating (Bo-Linn, Gentry, Lowman, Pratt, & Zhu, 2004; Centra, 1999). Each type of teacher rating is limited in its capacity to inform about Teacher Effectiveness (Peterson, 2000). But, some researches found that Self-evaluation or Self-rating provides important source of evidence for estimating Teacher Effectiveness because one's own perception about his strengths and weaknesses is a very important part of this estimation (Barge, 2012; Berk, 2005; Butler, 2001). Actually, self-evaluation is inherent in the process of teaching because, more or less every teacher evaluates him-self consciously or unconsciously after their teaching. Every teacher is an individual and has a different style of teaching and every teacher has something unique to offer to his students. So, by self-evaluation every individual teacher discovers the ways to become more effective (Johnstone, 1990; Lyandal, 1994; Ramsden, 1991). Overall, a teacher's self-evaluation demonstrates his knowledge about teaching and his perceived effectiveness in the classroom (Cranton, 2001). Nevertheless, for decades, teacher educators and researchers have struggled to determine various aspects of Teacher Effectiveness and its related characteristics and have found significant associations

between Teacher Effectiveness and its related characteristics (Aaronson, Barrow, & Sanders, 2003; Darling-Hammond, 2000; Harris & Sass, 2007; Mitchell et al., 2001).

### Teacher Effectiveness and Related Characteristics

*Effectiveness* of a teacher can be described as their success in helping students to learn and the *related characteristics* of effectiveness can be described as certain qualities which are related to teachers' effectiveness and which enable the teachers to achieve success in education (Walker, 2008). During last two decades, numerous researchers throughout the World have been studying related characteristics of Teacher Effectiveness.

In order to arrive at and identify the research gap on the area of the proposed study, a systematic review of related literature was conducted on '*Teacher Effectiveness and its related characteristics*'. For systematic review, certain definite steps were followed to survey the related literature. First, in planning stage, '*Inclusion and Exclusion Criteria*' were defined to identify the related literature systematically. Secondly, in the review stage, '*Summary of the Findings*' were analyzed and discussed after recording the identified studies in a '*Systematic Review Table*'. Thirdly, in the final stage, '*Research Gap*' was identified in the field of present investigation.

### Inclusion and Exclusion Criteria

During the planning stage of this study certain criteria were settled to select appropriate studies for the systematic review of related literature (see Table 1).

Table 1  
*Inclusion and Exclusion Criteria for the Systematic Review*

Criteria	Details
Year limit	Studies from 1990 to 2015 were included.
Mode of search	Only Computer based online Internet search was conducted.
Search engines	Google India Search, Yahoo India Search, Shodhganga search, in Calcutta University Website- SAGE Journals Online, Elsevier: SciVerse, Indian Journals, Springer-Journals Archive, CSI Publications, Indian Citation Index, Scopus and IEEE Journals were used.
Key words for search	teacher effectiveness, teacher effectiveness and related characteristics, effectiveness of secondary school teachers, teacher effectiveness in India, teacher effectiveness in West Bengal, teacher gender and teacher effectiveness, teacher effectiveness of male teachers, teacher effectiveness of female teachers, teacher effectiveness and academic disciplines, effectiveness of humanities teachers, effectiveness of social science teachers, effectiveness of science teachers, effectiveness of commerce teachers, teacher aptitude, teacher effectiveness and teacher aptitude, work task motivation of teachers, teacher effectiveness and work task motivation, personality characteristics of effective teachers, personality traits, big five personality traits, teacher effectiveness and big five personality traits.
Type of studies	Studies which adapted survey type researches were included.
Sample size	Studies only with large sample were included.
Publication type	Only published papers in peer-reviewed Journals, papers presented in seminars, online Doctoral dissertations and Master's theses were included.

### Data for Systematic Review

In the present systematic review, the investigator conducted a systematic search on the basis of the inclusion and exclusion criteria, as stated above (see Table 1). Only those studies which were published between the years of 1990 to 2015, were included. For searching the related literature, only the computer based online Internet searches were conducted through the *Search Engines* mentioned above (see Table 1). Only the studies which performed *Survey type* researches with *large samples* based on *Person related* and *Categorical variables*, were included and identified for systematic review. By searching with several permutations and combinations of the *Key words* through the Search Engines, related 244 studies were collected. With respect to the criteria 116 studies were excluded and finally 128 studies were selected and gathered in the pool of systematic table (see Appendix A).



## Summary of Findings

### Search Trend

By rigorous search through the Search Engines by the addition and alteration of the key words, a pool of 244 studies was constructed. After close scrutiny of the introduction, literature review and references of each study, on the basis of the inclusion and exclusion criteria for this research, nearly 48% of the 244 studies i.e., 116 studies were excluded due to the mismatch of criteria and finally 128 studies comprising of 117 papers published in peer-reviewed Journals, 8 Doctoral dissertation, 2 Master's thesis and 1 paper presented in seminar were selected for systematic review. The various research trends on the studies conducted on Teacher Effectiveness and related characteristics are discussed further.

### Year-wise Research Trend on Teacher Effectiveness and Related Characteristics

The selected studies were recorded in a *Systematic Review Table* (see Table 2) and for collection and tabulation of the data regarding the selected studies, *Microsoft Excel Sheet* was used. Classifying the selected studies according to year on the basis of the tabulated data, interesting *year-wise trend* was revealed. It was found that nearly 68% (87) of the selected studies were published on or after the year 2011 and in that range, the 25 (19.53%) of the selected studies were only of the year 2013 which was found to be the highest among the years. Another 32% (41) of the selected studies were published in between 20 years range i.e., from the year 1990 to 2010 (see Figure 1).

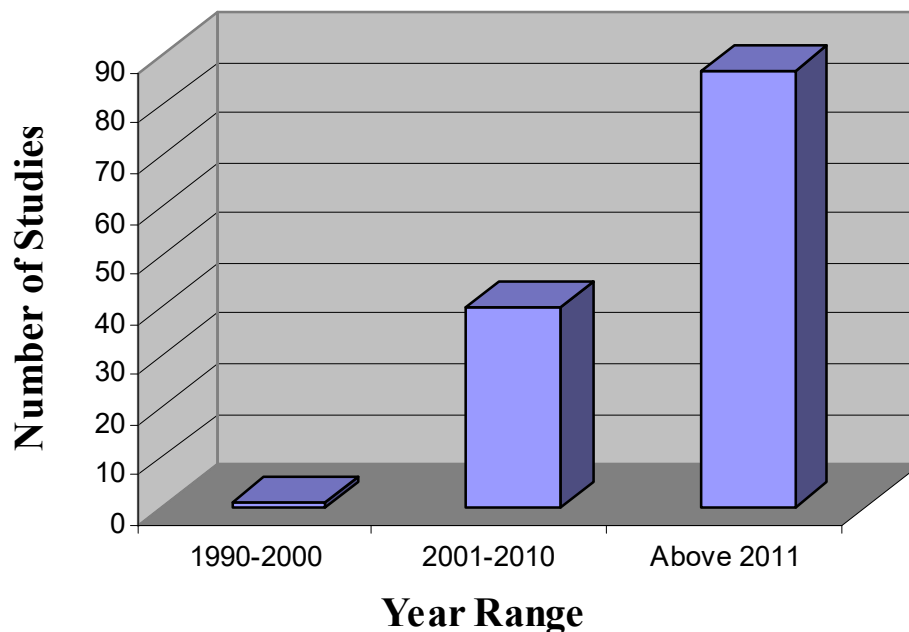


Figure 1. Year-wise trend of the selected studies on Teacher Effectiveness and related characteristics

### Research Trend Based on Continent/ Countries

*Research on Teacher Effectiveness and its related characteristics was an emerging area to the researchers throughout the World.* Most of the collected studies in the present systematic review were from the researchers of Asian countries (46.09%). According to the tabulated data, more than 32% (41) of the selected studies were from the continent America, of which highest studies were found from the country United States of America (USA) (28.13%). More than 14% (18) of the selected studies were found from the continent Africa of which maximum studies were found from the country Nigeria (9.38%). Few relevant studies were also found from the researchers of the European (6.25%) and Australian (1.56%) continents (see Figure 2).

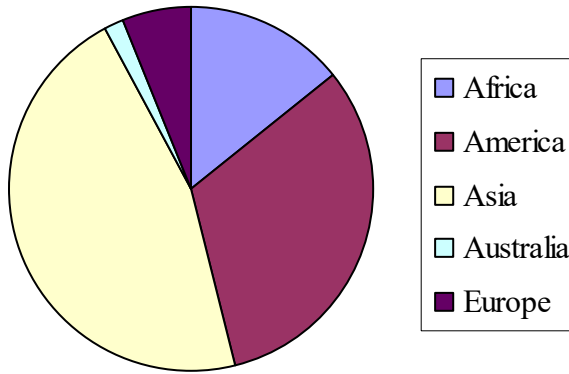


Figure 2. Research trend on Teacher Effectiveness based on Continent and Countries

**Research Trend on Teacher Effectiveness in India**

In all the countries of the World, India was at the first position according to its contribution in the selected literature (30.47%). In the selected studies the contributions of the Indian states like Punjab (7.03%), Haryana (3.91%) and Karnataka (3.91%) was very significant (see Figure 3). However, notably no studies were found from the state of West Bengal by online search through the search engines on the related literature.

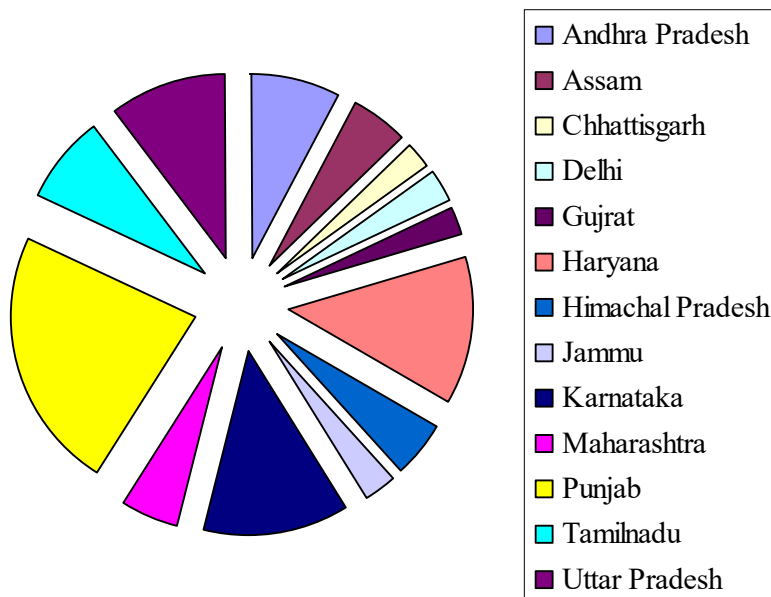


Figure 3. Represents Research on Teacher Effectiveness based on Indian Studies

**Research Trend Based on Related Characteristics of Teacher Effectiveness**

From the selected studies, it was found that numerous researchers throughout the World were keen to study various related characteristics of Teacher Effectiveness. According to the systematic review of the selected studies, the distinguished related characteristics of Teacher Effectiveness could be broadly categorized (see Figure 4) as School related Characteristics (35.94%), Teaching related Characteristics (10.15%) and Teacher related Characteristics (53.91%).

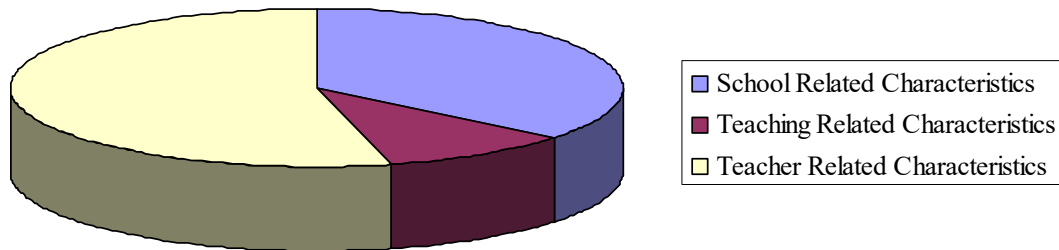


Figure 4. Research trend on related characteristics of Teacher Effectiveness based on broad categories (School related, Teaching related and Teacher related Characteristics)

**Research trend based on Teacher Effectiveness and school related characteristics.** From the selected studies it was found that various school-related characteristics were investigated in relation to Teacher Effectiveness throughout the World (see Table 3). Among the *school related variables* researchers were highly interested to study the relationship between *Teacher Effectiveness* and *Students' Achievements* and nearly 5% of the selected studies investigated the aforementioned relationship (e.g. Akinmusire, 2014; Farooq & Shahzadi, 2006; Heck, 2009; Konstantopoulos & Chung, 2011; Stronge, Ward, & Grant, 2011; Stronge, Ward, Tucker, Hindman, McColsky, & Iioward, 2007). Nearly 4% of the selected studies investigated the relationship between *Teacher Effectiveness* and *Perception of the current students about teaching* (Bezold, 2012; Gentry, Steenbergen-Hu, & Choi, 2011; Hoque, Razak, Zohora, & Islam, 2013; Jahangiri & Mucciolo, 2008; Saville, Zinn, Brown, & Marchuk, 2010). More than 3% of the selected studies investigated the relationship between *Teacher Effectiveness* and *Students' evaluation of teaching* (Malikow, 2005; Owoyemi & Adesoji, 2012; Pama, Dulla, & Leon, 2013; Stark-Wroblewski, Ahlering, & Brill, 2007). Similar trend was maintained in case of the relationship between *Teacher Effectiveness* and *Type of Management* of the school (Khurshid, 2011; Manu & Yellappa, 2013; Rajammal & Muthumanickam, 2012).

**Research trend based on type of school.** In the existing literature near about 25 (19.53%) studies were found from different countries of the World which investigated the effectiveness of the secondary school teachers. *From systematic review, it was also found that in the Indian scenario, researchers were very much interested to study Teacher Effectiveness of secondary school teachers (14.84%) of various states of the country* (e.g. Bhagat, 2015; Bhullar & Bala, 2014; Islahi & Nasreen, 2013; Manu & Yellappa, 2013; Pachaiyappan & Raj, 2014; Riti, 2010; Sharma, 2012; Singh & Babita, 2014a; Sodhi, 2010; Tyagi, 2013).

Table 3

*Selected Studies on Teacher Effectiveness and School Related Characteristics*

School Related Characteristics	Selected Studies
Students' Belief	Kodero, H. M. N., Misigo, B. L., Owino, E. A., & Simiyu, C. K. (2011)
Student Achievement	Stronge, J. H.; Ward, T. J. & Grant, L. G. (2011); Stronge, J. H., Ward, T.J., Tucker, P.D., Hindman, J.L., McColsky, W., & Iioward, B. (2007); Farooq, S. M., & Shahzadi, N. (2006); Heck, R. H. (2009); Konstantopoulos, S., & Chung, V. (2011); Akinmusire, P. A. (2014).
Student attentiveness	Madsen, K. (2003)
Student attitudes	Açikgoz, F. (2005)
Student test scores	Rockoff, J. E., Jacob, B. A., Kane, T. J. & Staiger, D. O. (2009)
Characteristics of students	Pagani, L., & Seghieri, C. (2002)
Courses influence	Pagani, L., & Seghieri, C. (2002)

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Students' evaluation of teaching	Owoyemi, T. E., & Adesoji, F. A. (2012); Stark-Wroblewski, K., Ahlering, R. F. & Brill, F. M. (2007); Malikow, M. (2005); Pama, A. B., Dulla, L. B., & Leon, R. C. D. (2013)
Students academic performance	Akiri, A. A., & Ugborugbo, N. M. (2009)
Student participation	Walls, R. T., Nardi, A. H., Minden, A. M. V., & Hoffman, N. (2002); Hussain, L., Khan, A. N., Shah, M., & Sibtain, M. (2011)
Student learning	Sadler, P. M., Sonnert, G., Coyle, P. H., Smith, H. P. N., & Miller, J. L. (2013)
Student progress	Napoles, J., & MacLeod, R. B. (2013)
Organizational climate of the school	Sodhi, B. (2010)
Administrative behaviour of school Principals	Riti (2010)
Type of management	Manu, V., & Yellappa, P. (2013); Rajammal, T. S., & Muthumanickam, R. (2012); Manu, V., & Yellappa, P. (2013); Khurshid, F. (2011)
School effectiveness	Teddlie, C., & Liu, S. (2008)
Habitat of school	Teddlie, C., & Liu, S. (2008); Rajammal, T. S., & Muthumanickam, R. (2012)
Students' views about teaching	Bartram, B., & Bailey, C. (2009)
Perception of the current students about teaching	Jahangiri, L., & Mucciolo, T. W. (2008); Bezold, R. A. (2012); Saville, B. K., Zinn, T. E., Brown, A. R. & Marchuk, K. A. (2010); Gentry, M., Steenbergen-Hu, S., & Choi, B. (2011); Hoque, K.E., Razak, A.Z.A., Zohora, M.F., Islam, R. (2013)
Perception of the past students about teaching	Jahangiri, L., & Mucciolo, T. W. (2008)
Students' Feedback	Kumar, S. (2014)
Principals' perception about teachers	Okolocha, C. C., & Onyeneke, E. N. (2013)
Principals' hiring, assigning, evaluating, and providing growth opportunities to teachers	Donaldson, M. L. (2013)
Monthly income of the teachers	Rajammal, T. S., & Muthumanickam, R. (2012)
Type and category of school	Lin, R., Xie, J., Jeng, Y., & Huang (2010); Al-Salameh, E. M. J. (2014); Pachaiyappan, P., & Raj, D. U. (2014).
Students' examination performance	Bett, W. K., Onyango, M., & Bantu, E. (2013)

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**Research trend based on Teacher Effectiveness and teaching related characteristics.** Among the selected studies it was found that researchers throughout the World were not so much interested on investigating the relationship between teaching-related characteristics and Teacher Effectiveness (see Figure 4 and Table 4). Though, among them 7 (5.47%) of the selected studies investigated the effect of *Teaching experience* on *Teacher Effectiveness* (Sodhi, 2010; Pachaiyappan & Raj, 2014; Manu & Yellappa, 2013; Tyagi, 2013; Omotayo, 2014; Pama, Dulla, & Leon, 2013; Rajammal & Muthumanickam, 2012).

Table 4

*Selected Studies regarding Teacher Effectiveness and Teaching Related Characteristics*

Teaching Related Characteristics	Selected Studies
Teaching experience	Sodhi, B. (2010); Pachaiyappan, P., & Raj, D. U. (2014); Manu, V., & Yellappa, P. (2013); Tyagi, S. (2013); Omotayo, B. K. (2014); Pama, A. B., Dulla, L. B., & Leon, R. C. D. (2013); Rajammal, T. S., & Muthumanickam, R. (2012)
Job satisfaction	Goel, S. (2011)
Instructional practices	Palardy, G. J., & Rumberger, R. W. (2008)
Effects of the challenges of teaching	Mohammed, I. A. (2008)
Teachers' training location	Islahi, F., & Nasreen (2013)
Medium of Instruction	Islahi, F., & Nasreen (2013)
Level of teaching	Rajammal, T. S., & Muthumanickam, R. (2012)

**Research trend based on Teacher Effectiveness and teacher related characteristics.** *Researchers in the World including India mostly interestingly investigated the relationship between teacher-related characteristics and Teacher Effectiveness and 69 (53.91%) of the selected studies were found covering these areas* (see Figure 4). Nearly 43 types of teacher-related variables were measured by the researchers to assess Teacher Effectiveness. These teacher-related variables can broadly be classified into two groups as *Categorical Variables* and *Person related Variables*.

**Teacher Effectiveness and categorical variables.** In the selected studies different types of categorical variables had been found which were used by the distinguished researchers throughout the World including India to study the nature of Teacher Effectiveness (see Table 5). On the basis of categorical variables, teachers can be classified into numerous groups e.g., in case of the categorical variable namely, *Habitat of the teachers*, they can be categorized according to their habitat like Rural teachers, Urban teachers, Semi-urban teachers. In this kind of studies some interesting trends were identified from the systematic review.

**Research trend based on training of the teachers.** More than 13% studies were found where effectiveness of the trainee teacher or student-teachers were investigated to assess the impact of the teachers' training on the Teacher Effectiveness (e.g. Andrew, Cobb, & Giampietro, 2005; Butler, 2001; Jarvis-Selinger, Collins, & Pratt, 2006; Kumar & Awati, 2012; Lemon & Garvis, 2013; Napoles & MacLeod, 2013). *No studies were found from the selected literature which investigated about the effectiveness of the trained teachers except a research paper of Kenya which studied about the ineffectiveness of the trained secondary school teachers* (Koderu, Misigo, Owino, & Simiyu, 2011).

**Research trend based on gender of the teachers.** None the less 23% studies were found which depicted the influence of gender on Teacher Effectiveness. *However, the results found from the studies were very much*

*conflicting and ambiguous.* Some studies (7.81%) found female teachers to be significantly more effective than the male teachers (e.g. Bandele & Oluwatayo, 2014; Bhagat, 2015; Muralidharan & Sheth, 2013; Rajammal & Muthumanickam, 2012). Few researchers (3.91%) found male teachers to be significantly more effective than their female counterparts (e.g. Akiri & Ugborugbo, 2008; Hussain, Khan, Shah, & Sibtain, 2011; Pama, Dulla, & Leon, 2013; Potvin, Hazari, Tai, & Sadler, 2009; Sharma, 2012). Insignificant differences (10.16%) in Teacher Effectiveness between the male and female teachers were also found by some studies (e.g. Akinmusire, 2014; Chowdhury, 2014; Islahi & Nasreen, 2013; Kumari & Padhi, 2014; Malik & Malik, 2014).

*Research trend based on academic disciplines of the teachers.* Near about 10% studies were found where the differences in Teacher Effectiveness were investigated with respect to their academic disciplines or their subjects of teaching (e.g. Arts, Humanities, Science, Commerce etc). *However, results found from the studies were contradictory and without uniformity or consistency.* Statistically significant difference in Teacher Effectiveness were found by Parikh, (2012) with respect to the academic disciplines of the teachers while a study, Pama, Dulla, & Leon (2013) found insignificant difference in Teacher Effectiveness with respect to academic disciplines of the teachers. In a study, Berry, O'Bryan, & Cummings (2004) found that Business & Commerce educators generally were less effective, while Yeboah-Appiagyei, Joseph, & Fentim, (2014) found that Accountancy and Commerce teachers were very effective.

Table 5  
*Selected Studies regarding Teacher Effectiveness and Categorical Variables*

Categorical variables	Selected Studies
Teachers' academic performance	Orphanos, S. A. (2008)
Training of teachers	Stronge, J. H., Ward, T.J., Tucker, P.D., Hindman, J.L., McColsky, W., & Iioward, B. (2007); Yeboah-Appiagyei, K., Joseph, O., & Fentim, D. B. (2014); Kodero, H. M. N., Misigo, B. L., Owino, E. A., & Simiyu, C. K. (2011)
Teacher qualifications	Liakopoulou, M. (2011); Manu, V., & Yellappa, P. (2013); Palardy, G. J., & Rumberger, R. W. (2008); Tyagi, S. (2013); Omotayo, B. K. (2014); Pama, A. B., Dulla, L. B., & Leon, R. C. D. (2013); Kiadese, A. L. (2011); Manu, V., & Yellappa, P. (2013)
Marital Status of the teachers	Tyagi, S. (2013); Islahi, F., & Nasreen (2013); Rajammal, T. S., & Muthumanickam, R. (2012)
Habitat of the teachers	Malik, U., & Kapoor, S. (2014); Sodhi, B. (2010); Bhullar, K., & Bala, R. (2014); Pachaiyappan, P., & Raj, D. U. (2014); Manu, V., & Yellappa, P. (2013); Parikh, A. D. (2012); Malik, U. & Pramila Malik, P. (2014); Kumari, A., & Padhi, S. K. (2014)
Age of the teachers	Tyagi, S. (2013); Pama, A. B., Dulla, L. B., & Leon, R. C. D. (2013); Rajammal, T. S., & Muthumanickam, R. (2012); Chowdhury, S. R. (2014); Al-Salameh, E. M. J. (2014)
Life satisfaction of teachers	Duckworth, A. L., Quinn, P. D., & Seligman, M. E. P. (2009)
Gender of the teachers	Tyagi, S. (2013); Parikh, A. D. (2012); Pama, A. B., Dulla, L. B., & Leon, R. C. D. (2013); Laird, T. F. N., Garver, A. K., & Niskodé, A. S. (2007, June); Wood, T. D. (2012); Islahi, F., & Nasreen (2013); Malik, U. & Malik, P. (2014); Bandele, S. O., & Oluwatayo, J. A. (2014)
Academic disciplines of the teachers	Malikow, M. (2005); Shishavan, H. B., & Sadeghi, K. (2009); Fouche, J. P. (2013); Tyagi, S. (2013); Parikh, A. D. (2012); Pama, A. B., Dulla, L. B., & Leon, R. C. D. (2013)

***Teacher Effectiveness and person related variables.*** In the selected literature, huge variations were noted in the types of person related variables used by the eminent researchers throughout the World including India, to study the nature of Teacher Effectiveness (see Table 6). Researchers were found to be more prone to investigate the relationship of Teacher Effectiveness with some of the person related variables like Teacher Skill (4.68%), Teacher Attitude (6.25%), Teacher Aptitude (7.03%) and Big-five Personality traits (5.47%). Near about 8% of the selected studies were found on Teacher Motivation but only two very comprehensive and

interesting studies were found where as a dependent variable Teacher Effectiveness were evaluated on the basis of Work Motivation as an independent variable. *From the close review of all the studies evaluating Teacher Effectiveness with respect to the person related variables, it was found that Teacher Aptitude, Work Motivation of the teachers and personality traits specially Big-five Personality traits of the teachers were the basic and basis to all person related variables.*

*Trends in uses of tools/ scales/ inventories to study Teacher Effectiveness and person related variables.* In more than 3% of the selected studies, the researchers used Teacher Aptitude Test (TAT) developed by Gakhar and Rajnish (2009) to assess aptitude of the Indian teachers (e.g. Chandel & Dhiman, 2014; Kanti, 2011; Kaur, Singh, & Sangha, 2014; Seetharaman & Rajasekar, 2013). Near about 5.5% studies evaluated personality traits of the teachers by using the World famous NEO-Five Factor Inventory developed by Costa and McCrae (1992) (e.g. Atta, Ather, & Bano, 2013; Birknerova, Frankovsky, & Zbihlejova, 2013; Ghanbary, Doroudian, & Ghasemi, 2014; Hopper, 2014; Melekeowei, 2014). Within the selected two studies which investigated the relationships between Teacher Effectiveness and Work Motivation, in a research paper Perlman (2013) used a very latest and comprehensive scale namely Work Task Motivation Scale for Teachers (WTMST) developed by Fernet, Senecal, Guay, Marsh, and Dowson (2008). Very significantly, near about 10% of the selected studies which evaluated Teacher Effectiveness of the Indian teachers (mainly secondary school teachers), collected data by Kulsum Teacher Effectiveness Scale (KTES) developed by Dr. (Mrs.) Umme Kulsum (2000) (Bhullar & Bala, 2014; Pachaiyappan & Raj, 2014; Seetharaman & Rajasekar, 2013; Singh & Babita, 2014a).

Table 6  
*Summary on Studies on Teacher Effectiveness and Person Related Variables*

Categorical variables	Selected Studies
Behaviors of the teachers	Harris, N. D., Ingle, W. K., & Rutledge, S. A. (2014)
Teacher Stress	Borkar, U. A. (2013)
Cognitive and non-cognitive teacher skills	Rockoff, J. E., Jacob, B. A., Kane, T. J. & Staiger, D. O. (2009)
Perceived characteristics by teachers	Açikgoz, F. (2005)
Teachers' accuracy	Madsen, K. (2003)
Teacher delivery	Madsen, K. (2003); MacLeod, R. B., & Napoles, J. (2012); Napoles, J., & MacLeod, R. B. (2013)
Perception of the teachers	Orphanos, S. A. (2008); Gao, M., & Liu, Q. (2012)
Teacher effects through training	Farooq, S. M., & Shahzadi, N. (2006)
Knowledge of the teachers	Liakopoulou, M. (2011); Sadler, P. M., Sonnert, G., Coyle, P. H., Smith, H. P. N., & Miller, J. L. (2013); Berry, K., O'Bryan, D., & Cummings, M. (2004)

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Teacher Characteristics	Pagani, L., & Seghieri, C. (2002); Kyriakides, L., Campbell, R. J., & Christofidou, E. (2002)
Teacher skill	Walls, R. T., Nardi, A. H., Minden, A. M. V., & Hoffman, N. (2002); Harris, N. D., Ingle, W. K., & Rutledge, S. A. (2014); Rockoff, J. E., Jacob, B. A., Kane, T. J. & Staiger, D. O. (2009); Liakopoulou, M. (2011); Sadler, P. M., Sonnert, G., Coyle, P. H., Smith, H. P. N., & Miller, J. L. (2013); Berry, K., O'Bryan, D., & Cummings, M. (2004)
Levels of emotional maturity	of Malik, U., & Kapoor, S. (2014)
Teacher qualities	Liakopoulou, M. (2011); Sadler, P. M., Sonnert, G., Coyle, P. H., Smith, H. P. N., & Miller, J. L. (2013); Berry, K., O'Bryan, D., & Cummings, M. (2004)
Verbal ability of the teachers	Andrew, M. D., Cobb, C. D., & Giampietro, P. J. (2005)
Teacher attributes	Sachs, S. K. (2004)
Teachers' preparation level	Boyd, D. J., Grossman, P. L., Lankford, H., Loeb, S., & Wyckoff, J. (2009)
Criterion of teachers	Strong, M., Gargani, J., & Hacifazlioglu, O. (2011)
Mental health of the teachers	Goel, S. (2011)
Emotional maturity of the teachers	Bhullar, K., & Bala, R. (2014)
Self-confidence of the teachers	Singh, G., & Babita (2014a)
Burnout of teachers	of Singh, G., & Babita (2014b); Singh, G., & Babita (2014c)
Creativity of the teachers	Kumar, A. G. H., & Awati, R. B. (2012); Toor, K. K. (2014)
Teacher attitude	Palardy, G. J., & Rumberger, R. W. (2008); Sharma, N. (2012); Kanti, K. S. (2011); Kumar, M. R. (2013); Hussainmiya, D. H., & Naik, R. H. (2015); Liakopoulou, M. (2011); Sadler, P. M., Sonnert, G., Coyle, P. H., Smith, H. P. N., & Miller, J. L. (2013); Berry, K., O'Bryan, D., & Cummings, M. (2004)

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Emotional Intelligence of the teachers	Bhagat, J. (2015)
Teacher Adjustment	Kumar, S. (2014)
General Intelligence of the teachers	Toor, K. K. (2014)
Leadership behaviors of teachers	Aslam, T. M., Ali, Z., Tatlah, I. A., & Iqbal, M. (2012)
Confidence of the teachers	Hopper, S. B. (2014)
Social intelligence of the teachers	Birknerova, Z., Frankovsky, M., & Zbihlejova, L. (2013)
Factors affecting motivational level of the teachers	Din, M. N. U., Tufail, H., Shereen, S., Nawaz, A., & Shahbaz, A. (2012)
Work motivation of the teachers	Islahi, F. (2010); Perlman, D. J. (2013)
Personality trait of the teachers	Magno, C., & Sembrano, J. (2008); Othman, F. B. (2009); Khodadady, E., & Mirjalili, P. (2012); Hussainmiya, D. H., & Naik, R. H. (2015); Melekeowei, P. D. (2014)
Teacher Aptitude	Kaur, K., Singh, G., & Sangha, S. S. (2014); Chandel, K. S., & Dhiman, R. J. (2014); Kumar, M. R. (2013); Ghatvisave, S. (2012); Manu, V., & Yellappa, P. (2013); Seetharaman, D., & Rajasekar, S. (2013)

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### Research Gap

From the above systematic review of literature, some knowledge gaps were found – as identified below:

- The researchers and educationists throughout the World, including the Indian researchers were very much inquisitive about the researches on *Teacher Effectiveness and related Characteristics* and no studies were found on the related literature from *West Bengal, India* where the present proposed study was conducted.
- According to Indian and World scenario, though researchers were very much keen to study Teacher Effectiveness and related characteristics of the secondary school teachers, no studies were found from the selected literature which investigated about the *effectiveness of the trained teachers of secondary schools*.
- Though, the Categorical variables identified from Teacher related characteristics like *Gender and Academic disciplines* were mostly studied issues to assess Teacher Effectiveness, according to the recent trend of Educational researches, highly conflicting and contradictory results of this kind of study reinforced the need to study the relationships further on the trained teachers of secondary schools in West Bengal.
- From the rigorous survey of the related literature, further need was felt to study on the relationships between Teacher Effectiveness and the person related variables like *Teacher Aptitude, Work Motivation and Big-five Personality traits of the trained secondary schools teachers of West Bengal*.

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**Appendix A**  
Systematic Review Table

Author Year	& Journal/ Dissertation/ Thesis	Location	Objective	Variable		Nature of Tools Sample	Findings	
				Dependent	Independent			
Bhagat, (2015)	J. International Recognized Double- Blind Peer Reviewed Multidiscipl inary Research Journal	Jammu, India	To analyze the impact of Emotional Intelligen ce on teacher effectiven ess of secondary school teachers	Teacher Effectiven ess	Emotional Intelligence and gender of secondary school teachers	600 (300 Male and 300 the Female) secondary school teachers	Emotional Intelligenc e Inventory and Teacher Effectivene ss Scale (TES)  Emotional intelligence and Teacher Effectiveness are dependent on each other and Significant gender differences were found in Teacher Effectiveness of teachers (Females higher than males)	
Hussainmiy a, D. H., & Naik, R. H. (2015)	International Journal of Education and Psychologic al Research	Karnatak of a, India	To analyze the effects of Higher Qualificat ion, Teachers' Personalit y, Teacher's attitude and Teacher Effectiven ess on Academic Achievem ent in Social Science	Teacher Effectiven ess	Higher Qualification , Teachers' Personality, Teacher's attitude Academic Achievement in Social Science	52 teachers teaching Social Science subject and 156 secondary schools	Introversio n- Extraversio n Inventory developed by Ramanath Kundu, Teacher Attitude Inventoryd eveloped more on by S. P. Ahluwalia & Students Rating of Teaching Effectivene ss Scale by Shashikala Deshpande	The higher qualification teachers with Introversion personality type, Favorable attitude and Ineffective teaching will influence more on academic achievement of students in social science
Mandina, S., Chiheve, H. (2015)	Advances in & Social Sciences Research Journal	Zimbabw e	To find out the perceptio ns of teachers and learners of Principles of Accounts at ordinary level in	Teacher Effectiven ess Principles of Accounts	Perceptions of teachers and learners Principles of Accounts	6 teachers and 108 learners of Principles Accounts of Secondary schools and 2 education Inspector	Questionna ire, Interview and Observatio n schedules developed And to improve Teacher Effectiveness in teaching the subject	

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		secondary schools regarding streaming of learners how such perceptions impact on the teaching and learning of the subject			
Akinmusire, P. A. (2014)	Journal of Nigeria Pristine	To find out the relationship between Teachers' Effectiveness and Gender and Student's Academic Achievement in English Language	Teachers' Gender and student's academic achievement in English language	14 English teachers and 280 English students in senior secondary schools	Teaching Observation Scale (TOS) and English Reading and Comprehension Achievement Test (ERECAT) in English Language
Al-Salameh, E. M. (2014)	Journal of Jordan Applied Psychology	To investigate the work motivation of the primary stage teachers in relation to age, type of school, educational qualifications, and gender	Work motivation of the primary school teachers	Age, type of school, educational qualifications and gender of the teachers	312 primary school teachers
Atta, M., Ather, M., & Bano, M. (2013)	International Journal of Business and Social Science	To examine the relationship between personality traits	Emotional intelligence (EI)	Personality traits of the teachers	Male (n = 77) and females (n = 86) University teachers
					Wong and Law Emotional Intelligence Scale (WLEIS) and NEO-SS, positively correlated with extraversion, conscientiousness,

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		and emotional intelligence (EI), besides exploring the gender differences				Five Factor openness to Inventory experience (NEO-FFI) and agreeableness, and (1992) negatively with neuroticism
Bandele, S. O., & Oluwatayo, J. A. (2014)	Journal of Nigeria & Emerging Trends in Educational Research and Policy Studies	To investigate self-assessment of Chemistry teachers in secondary schools	Teacher Effectiveness of the teachers	Gender of 103 teachers (male=47, female=56)	86 secondary schools	Teacher female teachers rated their Teacher Effectiveness in Chemistry higher than the males while experience had no significant influence on self-assessment of teaching Effectiveness
Bhullar, K., & Bala, R. (2014)	International Journal of Applied Studies	To find out relationship between Teacher Effectiveness and emotional maturity of secondary school teachers	Teacher Effectiveness	Emotional maturity, Gender habitat of the teachers	160 secondary school teachers	Kulsum Teacher Effectiveness Scale (KTES) by Kulsum (2000) and Standardized Emotional Maturity Scale Significant difference in Teacher Effectiveness by and emotional maturity with respect to Gender but insignificant difference with respect to habitat of the teachers. Female teachers more effective than male teachers
Chandel, S., Dhiman, R. J. (2014)	Academic & Discourse: An International Journal	Himachal Pradesh, India To find out Teacher Aptitude of prospective teachers towards teaching	Teacher Aptitude	Gender of 100 male and 100 female trainees from B.Ed. Colleges	100	Teacher Aptitude Test (TAT) by Gakhar & Rajnish (2009) Male and female prospective teachers differ significantly in their overall Teacher

			profession				Aptitude	
Chowdhury, S. R. (2014)	The Clarion India	Assam, India	To study the difference in Effectiveness of secondary school teachers in relation to their gender, age experience and qualification	Teacher Effectiveness	Gender, age 250 experience and qualification of secondary school teachers	250 teachers (male=140 and female=110) teaching in different secondary schools	Teacher effectiveness scale developed by Dr. Shallen Puri and Prof. S.V. Gakhar published by the National Psychological Corporation	No significant difference in the effectiveness of secondary school teachers in terms of their gender, age, experience and qualification
Ghanbary, F., Doroudian, A. A., Ghasemi, M. H. (2014)	Research Journal of Sports & Sciences	Iran	To examine the relationship between personality characteristics with effectiveness of physical education teachers	Teacher Effectiveness physical education teachers	Big Five Personality Traits	234 physical education teachers	Teacher Effectiveness questionnaire (Costa & McCrae, 1992)	Positive relationship just between extraversion and responsibility of the personality dimensions of physical education teachers
Harris, D., W. K., Rutledge, A. (2014)	N. Ingle, & Research Journal	American Educational Research Journal	To find out the relationship between Teacher Effectiveness ratings by principals and teacher value-Added measures	Teacher Effectiveness	teacher value-Added measures	30 Principals and student teachers of all schools (FCAT) of Florida and District	Florida Comprehensive Assessment Test ratings were positively, but weakly, correlated Principals	Teacher value added measures and principal Test ratings were positively, but weakly, correlated
Hopper, B. (2014)	S. Thesis submitted for the Degree of Doctor of Philosophy	USA	To explore the relationship of pre-service teacher's	Big Five Personality Traits	teaching confidence, teaching experience	152 pre-service teachers in each group of University of North	Big Five factors of personality (McCrae & Costa, 1996)	Significant correlation between personality traits and Teacher Effectiveness

	of North Texas		self-reported measures of teaching confidence, teaching experience, and the association with the Big Five Personality Traits		Texas	the OCEAN model	and effective teachers' traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism as predictors of confidence and experience
Kaur, (2014)	H. Paripex-Indian Journal of Research	Haryana, India	To find the difference in Teacher Aptitude with respect to gender, academic discipline and habitat	Teacher Aptitude	Gender, academic discipline (Science, Arts/Commerce) & college students	70 B.Ed. student from teacher training & college	The Teaching Aptitude Test Battery (TATB) (T with respect to gender, academic discipline and habitat
Kaur, Singh & S. S. (2014)	K., Edubeam Multidisciplinary- online Research Journal	Panjab, India	To predict the Teaching Skills on the basis of Teacher Aptitude and Attitude towards Teaching	Teaching Skills	Teacher Aptitude and Attitude towards Teaching	100 Prospective Science Teachers	General Teaching Competence Scale, Teacher Teaching Attitude Inventory and TAT Teaching (Gakhar & Rajnish, 2009)
Kumar, (2014)	S. IOSR Journal Research & Method in Education	Haryana, India	To find out the Effect of Students' Feedback and Academic Discipline of Teachers on Teacher Adjustment of Secondary School Teachers	Teacher Adjustment	Students' Feedback and Academic Discipline of Teachers	41 (science) and 61 (non-science) Secondary School Teachers	Standardized Teacher Adjustment Inventory (Short Form) (MTAI) and Teacher Effectiveness Scale (TES) developed

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Kumari, A., & Padhi, S. K. (2014)	International Journal of Advanced Research in Education, India	To find the difference in Teacher Effectiveness with respect to Gender, habitat of the secondary schools teachers	Teacher Effectiveness	Gender and secondary schools teachers	200 of the secondary school teachers	Teacher Effectiveness Scale	Insignificant difference in Teacher Effectiveness with respect to Gender, and significant difference with respect to habitat of the secondary schools teachers
Malik, U. & Malik, P. (2014)	International Educational E-Journal	To find the difference in Teacher Effectiveness with respect to Gender, habitat of the senior secondary schools teachers	Teacher Effectiveness	Gender and senior secondary schools teachers	600 of the teachers (300 male + 300 female) of various senior secondary schools	Teacher Effectiveness Scale (Mutha & Mutha, 1999)	Insignificant difference in Teacher Effectiveness with respect to Gender, habitat
Malik, U., & Kapoor, S. (2014)	Global Journal of Arts Humanities and Social Sciences	To explore the Teacher Effectiveness of school teachers with different levels of emotional maturity	Teacher Effectiveness	Levels of emotional maturity, gender and habitat of the teachers	300 (150 male and 150 female) of the teachers	Teacher Effectiveness Scale and Emotional Maturity Scale	Significant difference found in Teacher Effectiveness with respect to different levels of emotional maturity gender and habitat wise
Melekewei, P. D. (2014)	International Journal of Research Development	To investigate the five personality model as correlates of Teacher Effectiveness in secondary schools	Teacher Effectiveness	Big Five Personality Traits of secondary school teachers	574 Junior Secondary School teachers	Teacher Effectiveness Questionnaire (Costa & McCrae, 1992)	Teacher personality, as a factor that impact positively on Teacher Effectiveness of Secondary School teachers, Teacher Effectiveness had significant negative

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							correlation with Neuroticism and significant positive correlation with Openness
Omotayo, B. (2014)	Journal of Nigeria K. Empirical Studies	To investigate the relationship that exists between teachers' characteristics (qualification, years of experience) and students' performance level in Senior Secondary School Financial Accounting	Performan Teachers' 200 Senior Secondary students	Secondary (qualification, years of experience)	200 Senior Secondary students	Qualificati on Experience Questionnaire (TQEQ) and Financial Accounting Achievement Test (FAAT)	A positive relationship and exists between teachers' characteristic s (Qualificatio n and Experience) performance level of the students in Financial Accounting
Pachaiyappan, P., & Raj, D. (2014)	IOSR Journal of Research & Method in Education	Tamilnad u, India To assess the Teacher Effectiveness of secondary and higher secondary school teachers	Teacher Effectiveness	Type of school, gender, habitat, experience, academic disciplines of the teachers	of 69 Secondary and Higher secondary school teachers	KTES (Kulsum, 2000)	Significant difference in Teacher Effectiveness with respect to habitat, academic disciplines and teaching experience but insignificant difference with respect to gender
Singh, G., & Babita (2014a)	International Educational E-Journal	Punjab, India To predict burnout of rural female secondary school teachers	Burnout of female secondary school teachers	Teacher Effectiveness and self-confidence	300 rural Government Secondary Schools	Burnout of inventory (Form Ed), KTES (Kulsum, 2000) and Self-	Significant negative relationship of both Teacher Effectiveness and self-



		on the basis of Teacher Effectiveness and self-confidence		Punjab	Confidence Inventory (ASCI)	confidence with burnout of rural female secondary school teachers	
Singh, G., & Babita (2014b)	Multidisciplinary Journal e-India	Punjab, India	To predict burnout of female secondary school teachers on the basis of Teacher Effectiveness and self-confidence	Burnout of female secondary school teachers and self-confidence	300 female teachers of Government Secondary Schools of Punjab	Burnout inventory (Form Ed), KTES (Kulsum, and Self-Confidence Inventory (ASCI))	Significant negative relationship of both Teacher Effectiveness and self-confidence of female secondary school teachers
Singh, G., & Babita (2014c)	Multidisciplinary-Online research journal	Punjab, India	To predict burnout of male secondary school teachers on the basis of Teacher Effectiveness and self-confidence	Burnout of male secondary school teachers and self-confidence	300 male teachers of Government Secondary Schools of Punjab	Burnout inventory (Form Ed), KTES (Kulsum, and Self-Confidence Inventory (ASCI))	Significant negative relationship of both Teacher Effectiveness and self-confidence of male secondary school teachers
Toor, K. K. (2014)	MIER Journal of Educational Studies	Punjab, India	To study Teacher Effectiveness, general intelligence and creativity of secondary school teachers in relation to gender	Teacher Effectiveness, general intelligence and creativity of secondary school teachers	850 secondary school teachers from 172 schools of 9 <sup>th</sup> & 10 <sup>th</sup> grade	Teacher Effectiveness Scale by Kumar and Mutha (1999), The Standard Progressive Matrices (SPM)	Insignificant difference in Teacher Effectiveness with respect to gender
Yeboah-Appiagyeyi, K., Joseph, O., & Fentim, D.	International Journal of Research & Social Sciences	Ghana	To examine the effects of professional accounting	Academic performance of professional accountants of financial record	29 teachers from the 7 senior high schools and financial record	Questionnaire developed by sound professional training and	Teachers who possess sound professional training and

B. (2014)		al students	accounting teachers	collected about their students		qualification are well-equipped with the requisite competencies that enable them to promote effective teaching and learning in financial accounting	
Bett, W. K., Onyango, M., Bantu, E. (2013)	Kenya International Journal of Advance Research	To find out role of teacher motivation on student's examination performance at secondary school	Student's examination performance	Teacher motivation	104 students and principals of secondary school	Questionnaires developed	Motivation of teachers increase students' performance in examination
Birknerova, Z., Frankovsky, M., Zbihlejova, L. (2013)	American International Journal of Contemporary Research	Slovakia To find out relationships between Social intelligence factors and personality traits of the teachers	Social intelligence factors	Personality traits of the teachers	552 elementary school teachers	Tromso Social Intelligence Scale and NEO-FFI (Costa & McCrae, 1992)	Social intelligence factors are connected to the personality traits of these teachers
Borkar, U. A. (2013)	International Journal of Humanities and Social Science Invention	Maharashtra, India To study the effectiveness of Secondary School Teachers in Relation to Teacher Stress	Effectiveness of Secondary School Teachers	Teacher Stress	1000 Secondary School teachers	Teacher Effectiveness Scale by Kumar Mutha and Teacher Stress Inventory developed	Teacher Stress was negatively correlated with Teacher Effectiveness and Teacher Stress also varied gender wise
Donaldson, M. L. (2013)	Educational Administration Quarterly	USA How principals hire, assign,	Teacher Effectiveness	Principals' hiring, assigning, evaluating,	30 principals of elementary	Semi structured interviews, interview	Principals tended to nominate hiring and

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		evaluate, and provide growth opportunities to teachers likely have major ramifications for Teacher Effectiveness and student learning	and providing growth opportunities to teachers	and secondary schools	transcripts, professional I used development thematic summaries, categorical matrices, and analytical memos	
Fouche, P. (2013)	J. International South of Africa Education Science	To analyze the skills required from entry level accountants and to formulate what are seen as effective teaching methodologies in commerce	Teacher Effectiveness in Commerce	Skills in commerce teaching	and 177 students in first-year Financial Accounting class	Questionnaire developed Commerce teachers still focus on subject content and teaching methodologies mainly content driven, although various elements of effective teaching methodologies are present
Gupta, & Gehlawat, M. (2013)	Educationia Haryana, India Confab	To compare the job satisfaction and motivation of secondary school teachers with respect to some demographic variables	Job satisfaction and work motivation of secondary school teachers	Gender, type of schools, secondary school teachers and educational qualification of secondary school teachers	400 Personal Data Sheet, Job Satisfaction Scale (JSS), Employees Motivation Schedule (EMS)	No significant difference was found in the job satisfaction and work motivation with respect to gender and significant differences with respect to type of schools, teaching experience and educational qualifications

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Hoque, K.E., Razak, A.Z.A., Zohora, M.F., Islam, R. (2013)	Journal of Malaysia Sociological Research	To find the impact of teacher-gender on primary student achievement	Student achievement	Impact of primary teachers' gender	of 30 teachers and 604 students of primary school	Questionnaire developed	Insignificant gender difference found in student achievement	
Islahi, F., & Nasreen (2013)	Universal Journal of Educational Research	Uttar Pradesh, India	To discuss the effectiveness of male and female teachers in relation to demographic factors	Teacher Effectiveness	Demographic factors like gender, marital status, training, location and medium of instruction	245 male and 237 female Secondary school teachers developed	Self-rating Teacher Effectiveness Scale (TES) exhibited significantly different effectiveness however variations were noticed with respect to different demographic factors	
Kalita, A., & Saha, K. (2013)	PARIPEX- Indian Journal of Research,	Assam, India	To study the effectiveness of teachers teaching English in the secondary schools	Teacher Effectiveness	Gender level effectiveness of teachers	and 70 English teachers, 40 female and 30 male teachers from 20 schools	Questionnaire adopted the effectiveness but the mean effectiveness score of male teachers was found to be slightly higher than the female teachers	
Kaur, N. (2013)	International Journal of Education Methodology	Punjab, India	To compare the effect of multimedia approach and the conventional teaching in terms of pupils achievement in Arts	Teaching Arts by multimedia approach	Teaching Arts by conventional method	50 students were boys and 50 were girls of 9 <sup>th</sup> grade	Intelligence Test and Lesson plan based Multimedia on two topics arts were prepared and used by the conventional investigator	Significant difference found and achievement of the pupils teaching Arts by multimedia approach higher than that of conventional method
Kumar, M. (2013)	Doctoral Research	Andhra Pradesh	To study the impact of gender on primary student achievement	Teacher Effectiveness	Gender	250 men & 250 women	Significant difference found in student achievement	

R. (2013)	dissertation submitted in Education, Acharya Nagarjuna University Nagarjuna Nagar, Andhra Pradesh, India.	Pradesh, the Teacher Effectiveness, Teacher Aptitude and attitude towards teaching Mathematics of prospective Mathematics teachers	the Teacher Effectiveness, Teacher Aptitude and attitude towards teaching Mathematics of prospective Mathematics teachers	Effectiveness	Teacher Aptitude towards prospective Mathematics teachers	250 women prospective teachers	Effectiveness, Teacher Aptitude and attitude towards teaching scale developed	gender difference in Teacher Effectiveness (females higher than males) and significant association among Teacher Effectiveness, Teacher Aptitude
Lemon, N., & Garvis, S. (2013)	Australian Journal of Teacher Education	Australia To find out the role of effective arts teachers in a primary school	To find out the role of effective arts teachers in a primary school	Teacher Effectiveness	Perceptions of service Teachers of Arts teachers	85 pre-service teachers of Victorian primary university, 121 pre-service Teachers of Queensland university	Questionnaire developed	Findings provide perceptions about the role of artists in schools, visiting arts galleries, current arts engagement in their own lives and confidence levels to teach the arts
Manu, V. & Yellappa, P. (2013)	International Indexed & Refereed Research Journal	Karnataka, India To compare Teacher Effectiveness of Secondary School Teachers according to their Aptitude, Gender, Qualification, Locality, Discipline, Length of Service, Type of School, Type of	To compare Teacher Effectiveness of Secondary School Teachers according to their Aptitude, Gender, Qualification, Locality, Discipline, Length of Service, Type of School, Type of	Teacher Effectiveness	Teacher Aptitude, Gender, Qualification, Discipline, Length of Service, Type of School, Type of Management of teachers	920 de, secondary school teachers from the state of Karnataka	KTES (Kulsum, 2000) Teaching Aptitude of Test Battery and General information schedule	Teacher Effectiveness correlated with Teacher Aptitude of the teacher and type of Management have greater influence on Teacher Effectiveness of secondary School Teachers and Female teachers more effective than males

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Muralidhara NBER n, K., & Working Sheth, K. Paper (2013) 19341	Andhra Pradesh, No. India	To find the difference in Teacher Effectiven ess with respect to Gender	Teacher Effectiven ess	Gender of the schools teachers	Data of five years on students, teachers, and households of 500 governmen t-run primary schools (grades 1 through 5)	Teacher Effectivene ss Scale developed more effective overall	Female teachers more effective overall	
Napoles, J., Journal & Research in MacLeod, Music R. B. (2013) Education	of USA	To examine how teacher delivery and student progress influence d pre- service teachers' perceptio ns of overall Teacher Effectiven ess	Pre- service teachers' perception s of overall Teacher Effectiven ess	Teacher delivery and student progress of Teacher Effectiven ess	6 Experience & 75 pre-service teachers	Video tape and questionnai re developed	Positive correlation between perceptions of teacher delivery and student progress and teacher delivery best predicted the perceptions of overall Teacher Effectiveness	
Okolocha, Journal C. C., & Education Onyeneke, and Practice E. N. (2013)	of Nigeria	To study the secondary school principals , perceptio n of business studies teachers' Teacher Effectiven ess	Teacher Effectiven ess	Principals' perception of business studies teachers	261 public secondary school principals	Questionna ire developed	Business studies teachers ineffective in time & classroom management, lesson note preparation, delivery for optimal achievement of instructional goals, improved students' academic achievement s and consequently employabilit y	

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Onyekuru, B. U., & Ibegbunam, J. O. (2013)	Advances in Nigeria Science Research	To investigate Teacher Effectiveness of secondary school teachers with respect to teaching experience and teachers' qualifications and gender	Teacher Effectiveness	Teaching experience and teachers' qualifications and gender	80 secondary school teachers from 8 schools	Teacher Effectiveness Checklist	Teaching experience and teachers' qualifications had a significant influence on Teacher Effectiveness of the secondary school teachers while gender had no significant influence
Pama, B., Dulla, L. B., & Leon, R. C. D. (2013)	Catalyst Philippines	To examine the difference in Teacher Effectiveness with respect to gender, age, highest educational degree, length of service, academic rank and discipline	Teacher Effectiveness	Gender, age, highest educational degree, length of service, academic discipline and student's evaluation of teaching	127 faculty members and 3,810 students of Western Visayas College of Science and Technology	The Qualitative Contribution Evaluation (QCE)	Teacher Effectiveness yielded statistical difference between faculty gender, length of service, academic discipline and rank, but no statistical differences were found between age and highest educational degree (male teachers more effective than females)
Perlman, D. J. (2013)	Journal of Research, Policy & Practice of Teachers & Teacher Education	To examine if there were differences between elements of effective teaching based on pre-service teachers	Teacher Effectiveness	Teachers motivation toward teaching	68 (Male=44; Female=24) undergraduate Physical and Health Education secondary school pre-service teachers	Work Tasks Motivation Scale for Teachers (WTMST) by Fernet, Senécal, Marsh and Dowson, (2008) and Professiona	Motivation was associated with elements of effective teaching

		(PTs)					Teaching Standards Report (PTSR)	
Sadler, P. M., Sonnert, G., Coyle, P. H., Smith, H. P. N., & Miller, J. L. (2013)	American Educational Research Journal	USA	To examine the relationship between teacher knowledge and student learning	Student learning	Teacher knowledge	9,556 students of 181 middle school physical science teachers	MCQ type A form of Standardized questionnaire developed by the investigator	A form of pedagogical content knowledge, is an additional measure of teacher competence.
Seetharaman, D., & Rajasekar, S. (2013)	International Journal of Educational Research (IJTER)	Tamilnadu, India	To study the nature of relationship between Teacher Effectiveness and Teacher Aptitude	Teacher Effectiveness	Teacher Aptitude	820 B.Ed. Student teachers	KTES (Kulsum, 2000) TAT (Gakhar & Rajnish, 2009)	Teacher Effectiveness and Teacher Aptitude & significantly positively correlated
Tyagi, (2013)	International Journal of Engineering and Innovative Technology (IJEIT)	U. India	To deal with Teacher Effectiveness of secondary school teachers and their relation with demographic characteristics of secondary school teachers	Teacher Effectiveness of secondary school teachers	Demographic characteristics i.e. gender, social background, marital status, teaching subjects, age, qualification and school teaching experience of secondary school teachers	100 secondary school teachers	Questionnaire developed	The demographic characteristics (social background, marital status, school teaching experience, teaching subjects and qualification) influenced on different dimensions of their Teacher Effectiveness
Zaidi, N. R., Wajid, A., Zaidi, F. B., Zaidi, G. B., & Zaidi, M. T. (2013)	African Journal of Business Management	Lahore, Pakistan	To investigate the relationship between the big five personality traits and work engagement	The Big Five Personality Traits	Big Work engagement	399 teachers, 237 male and 161 female University teachers	Big Five Inventory (BFI) and Utrecht Work Engagement Scale (UWES)	Extraversion, agreeableness, conscientiousness, and openness to experience were found to be positively related to work



		nt among public sector University teachers					engagement. Neuroticism was negatively related to work engagement.
Arif, M. I., International Punjab, Rashid, A., Journal of Pakistan Tahira, S. Humanities S., & Social Akhter, M. Science (2012)	To measure and compare the Big Five Personality Traits of prospective teachers	Personality traits	Gender of 100 B.Ed students (60 Female & 40 Male) from 4 Government Universities	Big Five inventory (BFI)	Five	Openness personality trait of prospective teachers is more dominant as compared to remaining four big personality traits and females got greater score than males.	
Aslam, T. International Lahore, M., Ali, Z., Journal of Pakistan Tatlah, I. Physical and A., & Iqbal, Social M. (2012)	To find out the relationship between Personality characteristics and leadership behaviors of the teachers	Personality characteristics	leadership behaviors of the teachers	75 male and 75 female teachers of Govt. Secondary school	Goldberg's IPIP-NEO inventory and Leadership Questionnaire	Significant relationship between Personality characteristics and leadership behaviors of the teachers and extraversion, agreeableness, conscientiousness are related with both people and task oriented leadership styles	
Atta, M. A., Gomal & Jamil, A. University (2012) Journal of Research	To compare the performance of subject specialist regarding Teacher Effectiveness	Performance of the subject specialists	Effects of the selection procedure of the subject specialists	12 Principles, 12 Male teachers, 48 colleague teachers and secondary students.	A five points Likert type rating scale developed to collect the data regarding performance of subject specialists	Performance of the properly selected subject specialists better than others regarding Teacher Effectiveness	
Bezold, R. A. (2012) Doctoral dissertation submitted to	To explore and	Teacher Effectiveness	student perceptions of effective	103 students of mid-level	Questionnaire developed	Providing clear standards,	

	University of Missouri		describe student perceptions of effective teaching in the classroom	teaching	agricultural communications course		constant feedback, Scaffold the learning process, Encouraging strategic and meta-cognitive thinking were deemed as the most important teaching behaviors as perceived by the respondents
Chugh, (2012)	D. Researching Reality Internship	Haryana, India	To compare Teacher Aptitude according to gender	Teacher Aptitude	Gender of 275 the student- teachers	of 275 elementary teacher education	The Teaching Aptitude Test Battery (T A T B) No statistically significant difference was found in the Teacher Aptitude of male and female student teacher
Din, M. N. U., H., S., A., & Shahbaz, A. (2012)	Interdisciplinary Journal of Contemporary Research in Business	Pakistan	To examine the factors affecting motivational level of teachers at secondary school level	Motivational level of teachers	Factors affecting motivational level of teachers	20 male and 20 female secondary school teachers	Questionnaire developed Rewards and incentives, self confidence, economic status of teacher and financial incentive more affect the performance of teachers, while socio-status of the teacher, examination stress and teaching as first Choice of the teacher less affect the performance of teachers
Gao, M., & Liu, Q. (2012)	Journal of International	USA	To explore representative	Personality traits of effective	American and Chinese Secondary	80 American and 75 teachers	Narrations of the teachers possess or

	Society for Teacher Education		d in the teachers narratives of American and Chinese Secondary pre-service teachers	pre-service teachers' Perceptions	Chinese Secondary pre-service teachers		demonstrate adaptability, enthusiasm, fairness, high expectations, good humor, patience, and responsibility, and they are agreeable, caring, friendly, honest, and respectful
Ghatvisave, S. (2012)	Global Online Electronic International Interdisciplinary Research Journal (GOEIRJ)	Mumbai, India	To find the relation between Teacher Effectiveness and teaching aptitude	Teacher Effectiveness	Gender, Teacher Aptitude	300 secondary school teachers	Teachers Effectiveness Test (TET) by Pramod kumar and D.N. Muttha and Teaching Aptitude Test (TAT) by Jai Parkas and R. P. Srivastava
Hein, V., Ries, F., Pires, F., Caune, A., Emeljanovas, A., Ekler, J. H., & Valantiniene, I. (2012)	Journal of Europe Sports Science and Medicine	of Europe	To investigate how teachers' motivation to teach is related to different teaching styles in physical education	Teachers' motivation to teach	Effect Country difference	of 176 physical education teachers from five European countries	Teachers' motivation to teach, using more productive teaching styles by Roth, Assor, Kanat-Maymon, and Kaplan (2007) & among students and styles was a country estimated difference by teachers' self-reported data
Khodadady, E., & Mirjalili, P. (2012)	Continental Iran Journal of Education Research	Iran	To find the relationships between Characteri	Teacher Effectiveness of English Language Teachers	Personality traits of the Teachers	1260 learners and 118 English teachers	Persian version of English teachers' characteristics of Effective English
							Effective teachers' s- Rapport, Fairness,

		stics of Effective English Language Teachers and teachers' Personality traits			Language Qualification Teachers and (CEELT) Facilitation and NEO- correlated FFI (Costa significantly & McCrae, with the four 1992) dimensions of teachers' personality, i.e., Conscientiousness, Extraversion, Neuroticism, and Openness
Kumar, A. G. H., & Awati, R. B. (2012)	International & a, India Referred Research Journal	To study the Teacher Effectiveness of women student teachers in relation to their creativity	Teacher Effectiveness of 500 female teachers of Karnataka	Creativity of 2000) and Creativity test (verbal and Non verbal)	Creativity of the teachers significantly positively correlated with Teacher Effectiveness
Lenka, S. K., & R. (2012)	Academic Research International	Uttar Pradesh, India To investigate the relationship of leadership frustration and work motivation of secondary school teachers and leadership behavior of their heads	Leadership Frustration and work motivation of secondary school teachers	80 teachers and 20 heads of secondary school	Frustration Scale (RFS), Work Motivation Questionnaire of leadership behavior of heads and frustration of secondary school teachers and significant positive relationship between representation of leadership behavior of heads and frustration of secondary school teachers and significant positive relationship between work motivation of secondary school teachers and leadership behavior of their heads.
MacLeod, R. B., & Napoles, J. (2012)	Journal of Music Teacher Education USA	To examine pre-service teachers'	Teacher Effectiveness delivery	75 Music A University students and 4 male and 4 females	stimulus Video and Questionnaires Teacher delivery was the best predictor of perceptions

			perceptions of Teacher Effectiveness			female teachers	developed	of Teacher Effectiveness
Nompula, Y. (2012)	South African Journal of Education	South Africa	To optimize the limited teaching time, generally allocated to each art subject in schools, by developing a pedagogical strategy for its successful implementation	pedagogical strategy of Effective Arts Education	Teaching time	36 Creative Arts teachers and 1,052 learners of Grades 7–9	documentary analyses, interviews, and student group discussions	Integrate theory with practice within one art subject by teaching theoretical work in the context of practical work, thus optimizing the limited time allocated to arts and culture education in school timetables
Owoyemi, T. E., & Adesoji, F. A. (2012)	British Journal of Social Sciences	Nigeria	To establish specific criteria by which effective teaching can be evaluated	Teacher Effectiveness	students' evaluation of Teacher Effectiveness	2988 Senior Secondary Chemistry Students	Students' Evaluation of Teacher Effectiveness Scale	Students regard teacher-student interaction as the most important Teacher Effectiveness factor, while giving assignment is the least important
Parikh, D. (2012)	International Indexed Referred Research Journal	Gujarat, India	to study the difference in Teacher Effectiveness of teacher trainees of North Gujarat with respect to their Gender, Habitat and	Teacher Effectiveness	Gender Habitat Academic disciplines (Arts & Science) of the teachers trainees	, 94 teachers and trainees North Gujarat	Questionnaire developed	Significant difference in Teacher Effectiveness with respect to their Gender (Female higher than male) and Academic disciplines (Arts higher than Science) but insignificant in Habitat

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		Academic discipline s					
Rajammal, T. S., & Muthumani ckam, R. (2012)	International Journal of Current Research	Tamilnadu, India	To study the effectiveness of school teachers with respect to gender, place of school, level of teaching, marital status, age, type of managem ent, years of experienc e and monthly income of teachers	Teacher Effectiveness	Gender, place of school, marital status, age, and type of management, school experience and monthly income of teachers	900 school teachers of primary high school and secondary school in Chennai and Thiruvallur Districts of Tamilnadu	Teacher Effectiveness of school teachers' constructed and standardized by Mutha teaching and insignificant in
Saeed, A., & Muneer, R. (2012)	Interdisciplinary Journal of Contemporary Research in Business	Karachi, Pakistan	To evaluate the work of male and female secondary school teachers in Karachi	Work motivation of the secondary school teachers	Gender of the secondary school teachers	of 300 (74 Male & 226 Female) secondary school teachers	(74 questionnaire & re designed teachers were found to be more motivated to their work than male teachers
Sharma, N. (2012)	Journal of Department of Educational Studies, Delhi	Delhi, India	To study the relationship of Teacher Effectiveness with their adjustmen t and attitude towards teaching of secondary school teachers	Teacher Effectiveness	Gender, adjustment and attitude towards teaching of secondary school teachers	1000 secondary school teachers	Teaching Effectiveness Scale developed more effective than female teachers

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Wood, T. D. (2012)	International USA Electronic Journal of Elementary Education	To examine teacher perceptio ns of gender- based differenc s among elementar y school Teacher Effectiven ess	Teacher Effectiven ess	Perceptions of Elementary teachers of gender-based differences	215 Elementary teachers	Online survey	Elementary teachers perceive differences gender wise, male elementary teachers were perceived more negatively than female colleagues, a vast majority feel that more male elementary teachers needed in the elementary schools
Azih, N., & Nwosu, B. O. (2011)	Current Nigeria Research of Social Sciences	To investigat e the effects of instructio nal scaffold ing on the achievem ent of male and female students in financial accountin g	Achievem ent of male and female students in financial accounting	Effects of instructional scaffolding	of 163 students of financial accounting	Financial of accounting achievement test	Instructional scaffolding method was superior to the conventional method in improving the achievement of male and female students in financial accounting and gender had no significant interaction with teaching approach on students mean achievement
Gentry, M., Steenbergen-Hu, S., & Choi, B. (2011)	Gifted Child USA Quarterly	To identify most exemplar y and talented teachers by from their Student	Teacher Effectiven ess	Students' perceptions of Teacher Effectiveness	3,744 students and 404 elementary and secondary schools	My Class Activities (MCA) and Student Perceptions of Classroom Quality (SPOCQ)	Only 18 teachers identify most exemplary and talented teachers from 404 teachers

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			Perceptions				developed	
George, L., Canadian & Sabapathy, T. (2011)	Social Science	Karnataka, India	To find the importance of organizational commitment in work motivation of the teachers	Work organization of the commitment of teachers	450 degree college teachers city	Work Motivation Questionnaire and Organizational Commitment Scale adapted	A positive relationship and work motivation and organizational commitment of degree college teachers	
Goel, (2011)	S. Doctoral dissertation submitted to the Department of Education and Community Service, Punjabi University, Patiala	Punjab, India	to examine Teacher Effectiveness of school teachers in relation to their job satisfaction, personality and mental health	Teacher Effectiveness of school teachers in relation to their job satisfaction, personality and mental health	600 Government school teachers of Punjab	KTES (Kulsum, 2000), Job Satisfaction Scale, Personality Inventory and Mental Health Check list	Teacher Effectiveness related to Job satisfaction, personality and mental health of the teachers	
Hussain, L., Khan, A. N., & Sibtain, M. (2011)	Interdisciplinary Journal of Contemporary Research in Business	Pakistan	To study the effectiveness of Male and female teacher as perceived by their students	Teacher Effectiveness of Male and female teacher as perceived by their students	Gender and students' perception about effectiveness	80 students of Business school developed	Teacher Effectiveness Scale significantly higher than female	
Kanti, K. (2011)	S. Doctoral dissertation submitted in Education, Acharya Nagarjuna University, Andhra Pradesh, India	Andhra Pradesh, India	To study the values of prospective teachers in relation to teacher attitude and Teacher Aptitude	Values of the prospective teachers in relation to teacher attitude and Teacher Aptitude	Teacher attitude and Teacher Aptitude	650 prospective secondary school teachers	Teacher values inventory, Teacher attitude inventory and TAT (Gakhar & Rajnish, 2009)	They differ significantly in their levels of Teacher Aptitude and females had higher Teacher Aptitude than males
Khurshid, F. (2011)	British Journal of Humanities and Social	Pakistan	To explore the personality	Big Five Personality Traits	Gender and Institution management types of	300 from the public and 300 from the used	Mini Marker Set in Openness, Conscientious	Public sector teachers high in Openness, Conscientious



Sciences	y's Big Five Factors of the University teachers	University teachers	private sector universities which 278 were men and 322 were women	measure the personality of teachers 278 men and 322 women	ness and Neuroticism, while private sector teachers high on Agreeableness and Extraversion. Men have higher Extraversion while women high Agreeableness	
Kiadese, A. L. (2011)	International Journal of Vocational and Technical Education Nigeria	To investigate the Effectiveness of pre-vocational subject teachers with respect to gender and qualification	Teacher Effectiveness of the pre-vocational subject teachers	gender and 205 pre-vocational subject teachers from 50 secondary schools	Teaching Effectiveness Scale (TES) developed	Insignificant Teacher Effectiveness of pre-vocational subject teachers with respect to gender and qualification
Kodero, M. N., Misigo, B. L., Owino, E. A., & Simiyu, C. K. (2011)	SAGE Open Kenya	To examine the salient characteristics of trained ineffective teachers in secondary schools	Ineffective Teachers' Beliefs	80 secondary students, 40 female teachers and 40 male teachers	A biographic Participant s' opinions collected.	20 salient characteristics of trained and ineffective teachers in secondary schools
Konstantopoulos, S., & Chung, V. (2011)	American Educational Research Journal USA	To find out the persistence of teacher effects in elementary grades	Teacher Effectiveness of elementary grades	Student achievement 11,500 elementary students participated 4 years from kindergarten through Class 3	Stanford Achievement Test (SAT)	teachers affect student achievement positively in the elementary education and teacher effects persist though the Class 6

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<p>Liakopoulou, M. (2011)</p> <p>International Journal of Humanities and Social Science</p>	<p>To systematically record the qualifications, qualities, attitudes, skills and knowledge contribute to Teacher Effectiveness</p> <p>Teacher Effectiveness</p> <p>qualification 727</p> <p>s, qualities, attitudes, skills and knowledge of the teachers</p>	<p>A six-point Most Likert scale effective and open-ended questions their effectiveness at work with both personal traits and didactic and pedagogical skills, as well as pedagogical knowledge</p>
<p>Patrick, C. L. (2011)</p> <p>Assessment &amp; Evaluation in Higher Education</p>	<p>To examine whether the Big Five personality traits and expected student grades relate to student evaluations of teachers</p> <p>Student evaluation of Big teachers expected student grades</p> <p>Big Five Personality Traits and students</p> <p>176 University and students</p>	<p>Big Five Inventory (BFI)</p> <p>Extraversion, openness, agreeableness and conscientiousness were found to be personality traits favored in instructors, whereas neuroticism was not</p>
<p>Stronge, J. H., T. J., &amp; Grant, L. G. (2011)</p> <p>Journal of Teacher Education</p>	<p>To study the connection between Teacher Effectiveness and Student Achievement</p> <p>Teacher Effectiveness</p> <p>Student Achievement</p> <p>307 fifth-grade teachers and records of more than 4,600 fifth-grade students</p>	<p>Students' Achievement test &amp; Teacher Effectiveness</p> <p>Student Achievement depended on Teacher Effectiveness</p>
<p>Strong, M., Gargani, J., &amp; Hacifazlioglu, O. (2011)</p> <p>Journal of Teacher Education</p>	<p>To determine which criteria are most predictive of Teacher Effectiveness and whether the judges can correctly</p> <p>Teacher Effectiveness</p> <p>Criterion of 100 Teachers</p>	<p>Judges, no matter how experienced, are unable to identify successful teachers and certain cognitive Operations can predict effective teachers</p> <p>Judges, no matter how experienced, are unable to identify successful teachers and certain cognitive Operations can predict effective teachers</p>

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			rate effective teachers					
Islahi, (2010)	F. Doctoral dissertation submitted in India Education, Department of Education, Aligarh Muslim University, Aligarh, India.	Uttar Pradesh,	To study the Teacher Effectiveness with respect to different demographic factors viz., and the relationship between the teaching effectiveness of secondary school teachers and their work motivation	Teacher Effectiveness of training, medium of instruction, marital status and motivation of secondary school teachers	Gender, location, of training, medium of instruction, marital status and motivation of secondary school teachers	482 teachers was taken from various secondary schools of Uttar Pradesh	Teacher Effectiveness and Work Effectiveness scale developed and Work Effectiveness scale adapted	No significant difference in the Teacher Effectiveness with respect to gender, location and medium of Instruction, significant difference with respect to training and marital status and positive significant relationship found between Teacher Effectiveness and work motivation
Jennings, L. DiPrete, T. A. (2010)	J. Sociology & Education	USA	To estimate teacher effects on social and behavioral skills as well as on academic achievement	Social and behavioral skills as well as on academic achievement	Teacher Effectiveness	5,380 children taught by 1,050 teachers in 420 schools from kindergarten through class-3 data from Early Childhood Longitudinal Study (ECLS)	Approaches to Learning Scale, Self-Control Scale, and the Interpersonal Skills Scale	Teacher effects on social and behavioral skill development and larger than teacher effects on academic development and observable characteristics of teachers and the instructional approaches utilized in their classrooms were weak predictors of teacher effects
Lin, R., Jeng, Y., & Huang (2010)	Xie, Y., Journal of Arts and Sciences	Taiwan	To find the difference in teacher quality and effectiveness	Teacher quality and Teacher Effectiveness	Grade, Teacher Gender, School Type	40 students from 154 industrial vocational	Teacher quality and teaching effectiveness	Significant difference in dimensions of teacher

			quality and Teacher Effectiveness with respect to "Grade," "Teacher Gender," "School Type" and "School Category,"	ess	and School high Category schools	ss scale developed	quality and Teacher Effectiveness e.g. Personality, Performance Responsibility, Student problem handling, Teaching strategy, Classroom atmosphere Management but insignificant in total teacher effectiveness perceived by students with respect to gender	
Riti (2010)	Doctoral dissertation submitted to the Department of Education and Community Service, Punjabi University, Patiala	Himachal Pradesh, India	To study Teacher Effectiveness among secondary school teachers in relation to their school organizational climate and Administrative Behaviour of School Heads of Himachal Pradesh	Teacher Effectiveness	Organization Location of the teachers and Administrative Behaviour of School Heads	350 Government Secondary school teachers of Himachal Pradesh	KTES (Kulsum, 2000) and Organizational Climate Description Questionnaire (SOCDQ)	Significant difference in Teacher Effectiveness with respect to Organizational climate, Location of the teachers and Administrative Behaviour of School Heads
Saville, K., Zinn, E., A. R. & K. A. (2010)	B. Teaching of Psychology & A.	USA	To test the difference between perceptions of Teacher Effectiveness by the students gathered from	Students' perception of Teacher Effectiveness	Teaching brief and detailed Version of Syllabus	97 students (16 men, a 81 women) enrolled in undergraduate psychology courses at James Madison University	Questionnaire developed as possessing more of good teaching and a detailed syllabus might signal	

			brief version and a detailed Version of Syllabus					to students that their teacher is competent and wants them to do well
Schellenbach-Zell, J., & Grasel, C. (2010)	Journal for Germany Educational Research Online	To examine teachers' motivation and its supporting conditions	Teachers' motivation	Supporting conditions of chemistry teaching school teachers	350	Questionnaire developed	Autonomy, competence and relatedness were related to teacher motivation	
Sodhi, (2010)	B. Doctoral dissertation submitted to the Department of Education and Community Service, Punjabi University, Patiala	Punjab, India	To study Teacher Effectiveness among secondary school teachers in relation to their school organizational climate, gender, location, teaching experience and stream (science, social science and languages )	Teacher Effectiveness	Organization al climate, gender, location, teaching experience and stream of the teachers	450 Government secondary school teachers of Punjab	KTES (Kulsum, School Organizational Climate Description Questionnaire (SOCDQ))	Significant difference in Teacher Effectiveness with respect to Organizational climate but insignificant difference with respect to gender, location, teaching experience and stream
Akiri, A., Ugborugbo, N. (2009)	A. Stud & Comm Sci M. Higher	Home State, Delta, Nigeria	To determine the influence of teachers' classroom effectiveness on students academic Performance	Students academic performance	Teachers' classroom effectiveness	979 Teachers & 48,950 students	Two questionnaires and a rating scale	Effective teachers were found to be produce better performing students
Bartram, B., & C. (2009)	Active Learning in Higher	UK	To identify the extent	Teacher Effectiveness	Students' Views about effective	152 Overseas students	Questionnaire developed	UK and international students

<p>Education</p>	<p>to which difference s in understandings and expectations of effective teaching practice in Overseas students and UK students</p>	<p>teaching</p>	<p>and 116 UK students of University</p>	<p>appear to share broadly similar Views about effective teaching four key areas that underpin student understandings of effective teaching: teaching skills, teacher attributes, staff-student relationships and teacher knowledge</p>
<p>Boyd, D. J., Educational New Grossman, Evaluation York P. L., and Policy Lankford, Analysis H., Loeb, S., &amp; Wyckoff, J. (2009)</p>	<p>To estimate the effects of features of teachers' preparation on teachers' value added to student test score performance.</p>	<p>Teacher Effectiveness</p>	<p>Teachers' preparation level</p>	<p>Approximately 65,000 to 80,000 students in each grade through eighth grades</p>
<p>Duckworth, A. L., Quinn, D., &amp; Seligman, M. E. P. (2009)</p>	<p>The Journal USA of Positive Psychology</p>	<p>Teacher Effectiveness</p>	<p>The optimistic explanatory style, grit, and life satisfaction of teachers</p>	<p>390 novice teachers</p>
				<p>Student data by New York City Department of Education (NYCDOE) and Liberal Arts and Science Test New York (LAST) for City teachers.</p>
				<p>Results indicate variation across preparation of programs in the average effectiveness of the teachers and they are supplying to New York City schools the teachers.</p>

Heck, R. H. (2009)	Journal of USA Educational Administration	To show how increasing Teacher Effectiveness is central to school efforts to improve student outcomes	Teacher Effectiveness	Student Achievement	9,196 elementary students	Stanford Achievement Test (SAT Edition 9).	The effectiveness of successive teachers was related to student achievement and collective teacher effectiveness, as an organizational property of schools
Muller, K., Alliaata, R., & Benninghof, F. (2009)	Educational Management & Administrative Leadership	To examine the motivational prompts that people enter or leave the teaching profession	Teacher motivation	Motivation of teachers entering the teaching profession	590 Candidates or entering the primary teaching profession and 204 primary teachers taking early retirement	Questionnaires for Motivation s for Entering Teaching and Motivation s for Leaving Teaching designed	The characteristics of the job activities, working conditions and professional image, task, leadership, reward, professional development and social systems were the factors liable for attracting and retaining teachers
Othman, F. B. (2009)	Master's thesis for the degree of Master of Business Administration, University Sains Malaysia	Malaysia To examine the relationship between Personality Trait and Teacher Effectiveness	Teacher Effectiveness	Personality trait of the secondary school teachers	391 permanent teachers from Secondary Schools in Northern Region of Malaysia	of NEO-FFI (Costa & McCrae, 1992) and Teacher Effectiveness inventory developed	Significant & relationship between extrovert, agreeableness and conscientiousness with teaching effectiveness, while the neuroticism and openness have no significant relationship
Potvin, G., Hazari, Z., Tai, R. H., & Sadler, P. M. (2009)	Wiley Periodicals, Science Edition	USA To evaluate high school Teacher	Teacher Effectiveness	Gender of biology, chemistry, and physics college	of 6994 students and 4593 college teachers	Factors Influencing College Science Success	Male college teacher more effective than female teachers

		Effectiveness by their students according to the gender of the teacher	teachers	(FICSS)
Rockoff, J. NBER E., Jacob, Working B. A., Kane, Paper T. J. & Staiger, D. O. (2009)	New York	To study the characteristics of an effective teacher	Teacher Effectiveness and cognitive teacher & student test scores	418 Teachers Haberman PreScreene r for teachers, Minnesota Multiphasic Personality Inventory and student Achieveme nt test
Shishavan, H. B., & Sadeghi, K. (2009)	Iran	To characterize the qualities of an effective English language teacher (EELT) as perceived by Iranian English language teachers and learners	Teacher Effectiveness of English language teachers and learners	11 university professors, 18 High school English teachers and 30 teachers working at institutes and 99 university students, 89 pre-university students and 27 English learners from language institutes
Akiri, A., Ugborugbo, N. M. (2008)	of Nigeria	To examine the influence of gender on the effectiveness of secondary school	Teacher Effectiveness secondary school teachers	Gender of 460 male and 519 female secondary school teachers



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		teachers						
Deggs, M., Machtmes, K. L., & Johnson, E. (2008)	D. College Teaching Methods & Styles Journal	USA	To find out the difference in teaching Perspectives with respect to the different academic disciplines of the teachers	Teaching Perspectives of the teachers	Academic disciplines of the teachers	131 University teachers	The Teaching Perspectives Inventory (TPI)	Significant difference found in teaching Perspectives with respect to the different academic disciplines of the teachers.
Jahangiri, L., Mucciolo, T. (2008)	Journal of Dental Education	New York	To identify the characteristics of effective classroom teachers perceived by current and past students	Teacher Effectiveness	Perceived Teacher Effectiveness of current and past students	156 current medicine, dentistry, and past residency programs and 144 dentists and physicians who had graduated at least three years previously	Open ended Questionnaire developed	Three core categories: personality, process, and performance identified as the characteristic s of effective classroom teachers and difference found in the Perceived Teacher Effectiveness of current and past students
Magno, C. & Sembrano, J. (2008)	The Pacific-Asia Education Researcher,	Philippines	To test the effect of teachers' personality characteristics and teaching efficacy on teachers' performance and effective teaching	Teachers' performance and Teacher Effectiveness	Teachers' personality characteristics and teaching	296 teachers and 7,093 students from a community college	Student Instructional Report (SIR), the Effective Teaching Inventory (ETI), and the Learner-centered Practices Questionnaire, Osgood's Personality Characteristics Scale and the Teacher Efficacy Inventory	Teachers being effective does not result in high teaching performance ratings.

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Mohammed I. A. (2008)	Online Journal of Federal College of Education	Nigeria	To determine the challenge of teaching financial accounting in Nigerian secondary schools: A case study of Gombe State	Teacher Effectiveness	Effects of the challenges of teaching financial accounting	Nine (9) Secondary Schools were selected randomly for the study. The study covered the period 2003 to 2007	Examination and Statistics Department of the Ministry of Education haphazardly implemented and treated with lack of adequate instructional materials and/or poor ineffective teaching method	Challenges include poor academic performance of the Programme haphazardly implemented and treated with lack of adequate instructional materials and/or poor ineffective teaching method
Orphanos, S. A. (2008)	Master's thesis to Stanford University	Cyprus	To explore relationship between teachers' academic performance and perceived Teacher Effectiveness	Perceived Teacher Effectiveness	Teachers' academic performance	760 primary teachers.	Rating scale developed	Significantly positive association between teachers' academic performance and their perceived effectiveness.
Palardy, J., Rumberger, R. (2008)	G. Educational & Evaluation Policy Analysis	USA	To measure Teacher Effectiveness in grade	Student achievement	Teacher effectiveness, background qualification, attitudes, and instructional practices	5,034 students of class 1 from Early Childhood Longitudinal Study (ECLS)	Questionnaire developed	Background qualifications, is insufficient for ensuring Teachers Effectiveness in raising student achievement. and educational policy need to improve instructional practices and teacher attitudes.
Teddlie, C. & Liu, S. (2008)	School Effectiveness and School Improvement	China	To find out the relation of the Effectiveness and habitat of school	Teacher Effectiveness	Effectiveness and of school	300 habitat classroom observations of 12 primary schools	Classroom Snapshot (CS) of the Louisiana Component of Effective	Teacher Effectiveness and significantly related to Effectiveness and habitat of school

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		and Teacher Effectiveness				Teaching (LCET)	
Laird, T. F. Paper N., Garver, presented at A. K., & the Annual Niskodé, A. Meeting of S. (2007, the June) Association for Institutional Research, Kansas City	USA	To find the gender gaps in Teacher Effectiveness	Teacher Gender of 9,647 the teachers	Effectiveness	Faculty Survey of Student Engagements at baccalaureate degree-granting colleges and universities across the U.S	Gender differences found in Teacher Effectiveness and women faculty members tend toward active and interactive activities to a greater degree than men	
Rushton, S., Teaching Morgan, J., and & Richard M. (2007)	USA	To identify effective teacher personality traits	Personality Traits	Types of elementary school Teachers	of Study sample (N = 189), National study (N = 58), Florida sample (N = 804) elementary school Teachers of Florida	The Myers-Briggs Type Inventory (MBTI) and Beiderman Risk Taking (BRT)	Most effective teachers had Extraverted, Feeling, and Perceiving (ENFP) types of personality traits
Stark-Wroblewski & Ahlering, R. F. & Brill F. M. (2007)	USA	To document Teacher Effectiveness more comprehensively than through the use of student evaluations of teaching (SET) alone	Teacher Effectiveness	Student evaluations of teaching	165 University Students enrolled in eight sections of general psychology taught by 2 teachers	30-item multiple-choice test, 30-item post-test of SET	Faculty members should consider measures of student learning along with SETs in order to document Teacher Effectiveness
Stronge, J. H., Ward, T.J., Tucker, P.D., Hindman, J.L., McColsky,	USA	To find out the difference in Teacher Effectiveness and student	Teacher Effectiveness	Effects and Type of teachers	of 400 secondary teachers	Students' Achievement test developed	Differences found in some dimensions of Teacher Effectiveness as classroom management

W., & Lioward, B. (2007)		achievement on the basis of type of certification					& personal qualities but not in instruction or assessment and insignificant difference in student achievement on the basis of type of certification.
Farooq, M., Shahzadi, N. (2006)	S. Bulletin of Pakistan & Education & Research	To compare the effectiveness of teaching of professionally trained and untrained teachers on secondary school students' achievement	Student Achievement	Effects of 400 teachers' training	of 400 secondary students	Summative evaluation test by school	Teacher Effectiveness measured by student achievement was higher in trained teachers.
Jarvis-Selinger, S., Collins, J., & Pratt, D. (2006).	Teacher Education Quarterly	Canada To find out the influence of Academic Origins on Perspectives on Teaching	Perspectives on Teaching	Academic Origins on Perspectives on Teaching	356 of Secondary education students	The Teaching Perspectives Inventory (TPI)	Academic Origins of the student-teachers significantly influence Perspectives on Teaching
Açikgoz, F. (2005)	The Reading Matrix	Turky To study the effects of perceived Teacher characteristics on students attitudes	Student attitudes	Perceived Teacher characteristics	181 students of 9, 10, 11 grade	a questionnaire (TQ) in the Turkish mono-lingual setting three open-ended questions	Positive effects of perceived Teacher characteristics on students attitudes found.
Andrew, M. D., Cobb, C. D., Giampietro, P. J. (2005)	Journal of USA Teacher & Education	To analyze the role of verbal ability in	Teacher Effectiveness	Verbal ability of teachers	116 trainee of the teachers	Standardized questionnaires	Less effective teachers have lower average verbal scores

			teaching, and to presents research examin g the relationsh ip of teachers' verbal ability and Teacher Effectiven ess				
Madsen, K., & Cassidy, J. W. (2005)	Journal of USA Research in Music Education	To examine pre-service and exempted teachers' ratings and comment on Teacher Effectiven ess and student learning	Perception s of Teacher Effectiven ess and student learning	Different levels of teaching experience	78 University of Music teacher different experience level.	Comments of teachers recorded	Significant the difference were found in perceptions of Teacher Effectiveness and student learning with respect to experience.
Malikow, M. (2005)	National USA Forum of Teacher Education Journal	To quantify student evaluated Teacher Effectiven ess in order to ascertain the grade level, subject and characteri stics of exception ally effective teachers	Teacher Effectiven ess	Student evaluation of teaching	361 College students and 315 secondary teachers, social studies (89), English(89), mathematic s (55), foreign language (33), and science(27)	Questionna ire developed	Personality characteristic s most often cited by the students were: challenging/ had reasonably high expectations, sense of humor, enthusiastic, creative, caring, explaining capacity and flexible instructional style.
Berry, K., O'Bryan, D., & Cummings, M. (2004)	Journal of USA Information & Technology Education	To know the perceptio ns of knowledg (KSAs) of teachers	Knowledge and the abilities of teachers	Perceptions of Business & Commerce teachers	248 the secondary school business educators	Questionna ire developed	Business & Commerce educators generally had an

		e, skills, the and Business abilities & (KSAs) of Commerce the teachers Business & Commerce e teachers		in Illinois		incomplete and inaccurate opinion of the skills necessary to succeed in the information systems (IS) profession
Nye, B., Educational USA Konstantop Evaluation oulos, S., & Policy Hedges, L. Analysis V. (2004)	To find Teacher Student out the Effectiven achievement persistenc ess e of teacher effects in elementar y grades		11,500 Stanford elementary Achieveme students nt Test effects low participated (SAT) socioeconom 4 years ic status from (SES) kindergarte schools n through students and class 3 on mathematics achievement than reading, teacher experience had significant relationship with student achievement			
Sachs, S. K. Journal of USA (2004) Teacher Education	To determine Teacher Teacher whether Effectiven attributes teacher ess attributes identified by the instrumen t varied according to Teacher Effectiven ess		179 regular classroom elementary teachers	Questionna ire and a 5- point Likert-type scale	Attributes— socio- cultural awareness, contextual interpersonal skills, self- understandin g, risk taking and perceived efficacy unable to discriminate teachers according to effectiveness	
Madsen, K. Journal of New (2003) Research in York Music Education	To examine Teacher the effect ess of accuracy of instructio n, teacher delivery, and student	Accuracy of 168 instruction, secondary teacher music delivery, and students of student Grades 6- attentiveness 12.		A stimulus videotape and a 10- point Likert scale to rate the teacher in terms of significant effectivene ss	Accuracy of instruction, teacher delivery, and student attentiveness had significant effect on Teacher Effectiveness	

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			attentiveness on Teacher Effectiveness					
Kyriakides, L., Campbell, R. J., & Christofidou, E. (2002)	School Effectiveness and School Improvement	Cyprus, U.K.	To generate criteria for effectiveness was conducted in order to develop a complementary approach	Teacher Effectiveness	Teacher Characteristics	682 Elementary school teachers	Group Interview and questionnaire developed	51 Teacher Characteristics identified some of which can predict Teacher effectiveness
Pagani, L., & Seghieri, C. (2002)	Development in Statistics	Italy	To find which characteristics of students, instructors or courses influence Teacher Effectiveness	Teacher Effectiveness	Characteristics of students, instructors and courses influence	9561 questionnaires regarding 416 courses		Multiple items found to assess the quality of teaching and student ratings are one source (among many) of information for personnel decisions
Walls, T., Nardi, A., Minden, A. M. V., & Hoffman, N. (2002)	Teacher Education Quarterly	USA	To compare the characteristics of effective and ineffective teachers	Teaching-experience, Teacher Effectiveness dimension	Emotional environment, teacher skill, motivation, student participation, and rules and grades	30 prospective teachers, 30 novice teachers and 30 experienced teachers	Open ended questionnaire developed	Several characteristic of effective and ineffective teachers found
Butler, A. (2001)	Journal of Music Research in Education	USA	to explore the relationship between pre-service teachers' conceptions about effective teaching and their ability to demonstrate	Ability to demonstrate effective teaching behaviors	Conceptions about effective teaching	15 pre-service University Music teachers	Survey of Teaching Effectiveness (STE) (Hamann, Lineburgh, & Paul, 1998) and time-sampling procedure developed	No relationship between pre-service teachers' conceptions about effective teaching and their ability to demonstrate effective teaching behaviors

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effective  
teaching  
behaviors

<p>Tin, L. G., New Hean, L. L., Horizons in &amp; Leng, Y. Education L. (1996)</p>	<p>Malaysia</p>	<p>To know Motivation Level what of the teaching motivates teachers the teachers to teach</p>	<p>of 10 primary school teachers and 17 secondary schools teachers</p>	<p>In-depth interview designed</p>	<p>Teachers were motivated by students, by administrators, by the nature of the job itself and for some, the motivator was their religion</p>
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# THE METHOD OF FORMING SPATIAL REPRESENTATIONS AND IMAGINATION, CONSTRUCTIVE AND GEOMETRIC THINKING OF STUDENTS WHEN STUDYING DISCIPLINE "COMPUTER ENGINEERING GRAPHICS"

Dmitry MIROSHIN

Russian State Vocational Pedagogical University,  
Ural Institute of EMERCOM of Russia, Ekaterinburg  
mirdcom@rambler.ru

## ABSTRACT

The article describes the experience of application of method of formation of spatial representation and imagination, constructive and geometric thinking within the discipline «Computer engineering graphics», studied at a college. It describes the methods, methodological support and training element for the formation of a tentative scheme of steps of the learners for the typical graphics tasks organized during independent work. It describes a pedagogical experiment, analyzes the results of the experiment and gives recommendations for the implementation of the methodology.

**Keywords:** Computer engineering graphics, spatial representation and imagination, constructive and geometric thinking, a tentative scheme of action, modular approach, training element, pedagogical experiment.

## INTRODUCTION

The purpose of the discipline "Computer engineering graphics" at a college is the development of spatial representation and imagination, constructive and geometric thinking, determining capabilities of the students to the analysis and synthesis of spatial forms and relations on the basis of graphic models of space, practically implemented in the form of drawings of spatial features and dependencies.

The task of studying the discipline "Computer engineering graphics" is the learning of methods for obtaining certain graphic models of space based on orthogonal projection and the ability to solve by these models the tasks associated by spatial forms and relations.

## LITERATURE REVIEW

The objective of our study is the experimental approbation and devising methods of formation of spatial representation, imagination and constructive and geometric thinking in training sessions on discipline "Computer engineering graphics" and in the course of organized independent work that would allow students to form the creative level of graphic solution of problems in analysis and synthesis of spatial forms and relations based on the methods of transformation of graphic models of space. The study applies the methods of organization of educational work in the educational program of a college and during the pedagogical experiment.

We believe that it is possible to allocate three levels of development of spatial representation, imagination and constructive and geometric thinking: reproductive, productive and creative.

At the reproductive level learners are able to solve typical tasks of receiving graphical models of space based on orthogonal projection (level of reproductive abilities).

At productive level, learners are able to apply the methods of transformation of graphic models of space using the existing skills of solving typical problems of reproductive level for obtaining graphical models space based on orthogonal projection (level of productive skills).

On a creative level learners are able to solve creative tasks of the analysis and synthesis of spatial forms and relations based on the methods of transformation of graphic models of space, tasks of searching methods of transformation of spatial models depending on individual spatial objects (level of creativity).

We believe that the formation of spatial representation, imagination and constructive and geometric thinking is possible in two stages. At the first stage, students acquire an approximate scheme of action for solving typical graphical tasks of reproductive level during the independent study of a training element. At the second stage, learners solve graphic tasks of productive and creative level depending on the complexity of a topic. In the process learners follow an approximate scheme of action, practiced during independent work.

We believe that such training is possible to use with the subject modular approach to the organization of educational process on discipline "Computer engineering graphics", which is described in the works of M.Choshanov, N. Erganova, ets.

In this case, according to P. Juceviciene a module is the logically completed part of an educational discipline that corresponds to one topic.

It is developed suitable methodical support for lectures and practical classes, independent work of learners, and monitoring the level of formation of spatial representation, imagination and constructive and geometric thinking for each module. The structure of a methodical support of the module on the topic consists of lecture material that is accompanied by a multimedia presentation, a training element, reflecting the methodology of implementation of a typical graphic task and serving as a means of forming an indicative basis for the activity during independent work, the package of graphic assignments of creative level, designed to perform for students on the seminar. The primary means for independent work of students is a training element. The training element is a booklet that consists of a coordinating part, information and activity part and controlling part.

The coordinating part is designed to coordinate trainees in the field of the objectives of the study of a training element, equipment and tools necessary for its study, and also in the list of training elements prior to this training element. The example of the coordinating parts of the training item shown in the picture.

Information and activity part of the training element consists of two columns: the left column contains completed text paragraphs which are the algorithm of the assignment and on the right side each text paragraph is aligned to reference pattern illustrating the step of the algorithm described in the paragraph. The example of information and activity part of the training element shown in the picture.

The controlling part of the training element is a list of control tasks with forms of responses that the learner fills in after learning the educational item, and a sample of completing the graphic tasks described in the training element. The example of the controlling part of the training element on the theme is shown in the figure.

The educational process in the study of each module is included in the general system classes in high school and has a gradual organization.

At the first stage of studying the topic it is two hour lecture. In the first hour of the lecture it is considered the theoretical position on the topic using multimedia systems as well as revealed the practical application of the studied educational material.

In the second hour of the lecture in detail worked out the training element, oriented to perform typical graphic task on the subject matter.

The second stage is that during independent work students learn a training element and execute typical graphic task by the method described in the training element. It is recommended the following sequence of work with the training element:

1. Read the learning objectives of the training element, to prepare the necessary drawing tools, sheets of paper in the specified format.
2. Based on the summary of the lecture, to learn the appropriate training material in a textbook, proposed by the teacher as the primary on the subject.
3. Refer to issued training element. The trainee is encouraged to consistently study the text material presented in meaningful paragraphs of left part of the training element, simultaneously with the study of the text material it is proposed to analyze the illustration corresponding to the studied paragraph and to establish the correspondence between textual content and its graphic reflection in the right part of the training element.
4. To close the test part of the training element and to restore the meaning and method of implementation of graphical task by the illustrations given in the right part.
5. To take the prepared sheet of paper in the proper format, to prepare the drawing tools given in the description of the equipment on the coordination page of the training element.
6. To close the right (illustrative) part of the training element and to perform the graphical task of the training element using the methodology of the work described in the text part of the training element.
7. After completing the job, to compare received graphical image with the image given in the controlling part of the training element, to identify errors, and to correct them focusing on the illustrative part of the learning element.

8. To turn to questions for self control, given in the controlling part of the training element and to answer them by filling out a response form.

The standard graphic tasks and forms with responses performed using the training element shall be passed to the Department to check by the lead teacher in strictly defined time, usually within seven days after the lecture on the subject matter.

The third stage aims at the formation of the creative level of graphical tasks' implementation and it is implemented on the seminar. At the training seminar each student gets their own variant of the implementation of creative learning task to image various graphic objects in drawings. Performing creative tasks activates the intelligence capacity of the learner, forcing him to seek solutions to non-standard tasks using approximate scheme of action acquired during learning the training element.

Thus, during the third stage the trainees perform creative graphic tasks, which leads to the formation of their abilities to think outside the box and to apply existing knowledge and skills in new practical situation, the development of cognitive activity and creativity, and, ultimately, helps to the formation of creative perception of space and the development of spatial representation, imagination and constructive and geometric thinking.

### RESEARCH METHOD

Experimental testing of the described method of forming a spatial representation, imagination and constructive and geometric thinking was conducted during the training on the discipline "Computer engineering graphics" and has been used in Russian State Vocational Pedagogical University in preparing teachers of vocational training and in the Ural Institute of State Fire Service of EMERCOM of Russia in specialty training "Fire safety".

In the experimental testing were involved four groups of students of Russian State Vocational Pedagogical University and four groups of cadets of the Ural Institute of State Fire Service of EMERCOM of Russia. The total number of participants of the experimental approbation was 180 persons.

In experimental approbation have been developed criteria of an estimation of level of formation of spatial representation, imagination and constructive and geometric thinking of students, and in particular:

- reproductive level was estimated in the range from 0 to 10 points;
- productive level was estimated in the range of 0 to 20 points;
- creative level was estimated in the range from 0 to 30 points.

The range of scores was identified for assessment of the completeness and correctness of fulfillment of graphic tasks.

The experimental approbation included ascertaining, forming and control stages.

On ascertaining stage of the experimental approbation using the test methods and the package of control tasks there were identified the initial level of formation of spatial imagination of the four groups of students and four groups of cadets and calculated the average value of the level of formation of spatial representation, imagination and constructive and geometric thinking of students and cadets. According to the results of the findings there were generated two control groups and two experimental groups with a similar level of formation of spatial representation, imagination and constructive and geometric thinking.

A comparative experiment was conducted over one semester. In the course of the experiment there were studied such topics as:

- "Projection of straight lines";
- "Projection of planes";
- "The methods of conversion of projections";
- "Axonometric projection of lines and planes";
- "The projection of geometric solids. Scanning of the surface of geometric solids";
  - " The intersection of the geometric solids. The construction of the lines of intersection by the method of auxiliary clipping planes"
- "The intersection of the geometric solids. The construction of the lines of intersection by the method of auxiliary intersecting spheres".

In the control group the classes were conducted on traditional lecture and seminar techniques of teaching in a college. Learners listened to the lecture material and there were conducted seminars using the graphical tasks for the creative level of formation of spatial representation, imagination and constructive and geometric thinking. The independent work of the learners was to prepare for seminar, to study textbooks and lecture notes.

In the experimental groups classes were carried out according to the method described above using the training elements for forming an indicative basis for the activity during independent work of students.

In the control phase, the learners of the control and experimental groups were offered integrated graphic work with graphic assignments of reproductive, productive and creative level. According to the results of integrated graphic work there were calculated the average score for each student.

The results of the experiment are shown in figure.

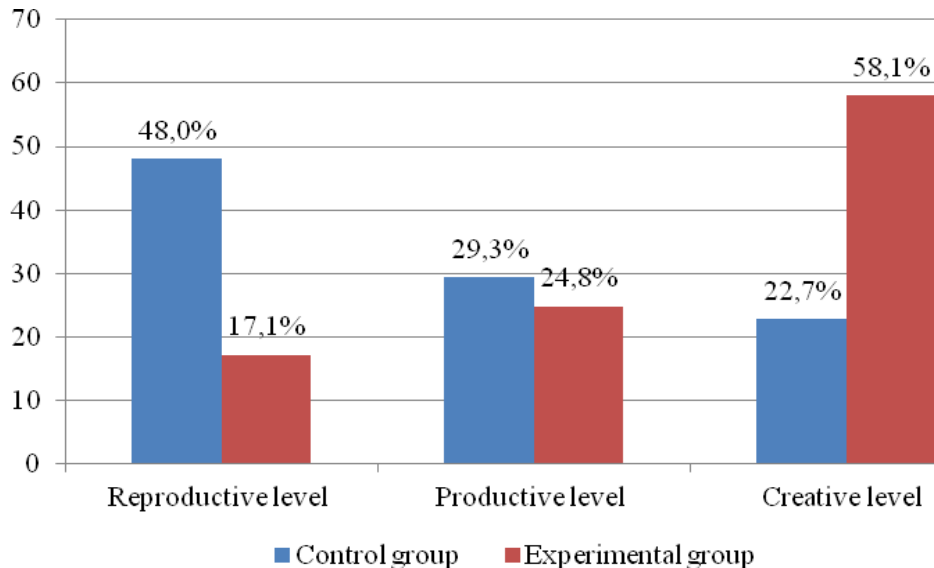


Figure1. Experimental results

The results of the experiment show that in the control group 48 % of students had performed integrated graphic work on the reproductive level, 29,3% - on the productive level and only 22.7 % on the creative level, almost half of the learners were unable to rise above the reproductive level of formation of spatial representation, imagination and constructive and geometric thinking. In the experimental group only 17.1 % of the learners were unable to rise above the reproductive level. 24.8 % of the learners had reached productive level of formation of spatial representation, imagination and constructive and geometric thinking. More than half (58.1 percent of the students) had reached creative level.

## DISCUSSION AND CONCLUSION

The analysis of the experimental results confirms the high efficiency of the developed method of formation of the indicative schemes of action through the use of training elements as part of an organized independent work of students in the study module on the topic. We can assume that the use of the developed methodology and methodological support can significantly increase the level of formation of spatial representation and imagination, constructive and geometric thinking that determine the capabilities of students to the analysis and synthesis of spatial forms and relations on the basis of graphic models of space, practically implemented in the form of drawings of specific features and dependencies. Extrapolating the experimental results to other technical disciplines we can assume that the technique will also be effective in the study subjects, the content of which requires the solution of standard engineering problems, and the development of productive and creative level in the design and engineering of the subject.

The examples of such disciplines may include: theoretical mechanics, theory of mechanisms and machines, machine elements, mechanics of materials, materials, equipment industry, etc.

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## TRANSITION TO MULTIDIMENSIONAL AND COGNITIVE DIAGNOSIS ADAPTIVE TESTING: AN OVERVIEW OF CAT

Lokman Akbay, PhD  
Educational Statistics & Measurement  
Rutgers, The State University of New Jersey  
lokmanakbay@gmail.com

Mehmet Kaplan, PhD  
Educational Statistics & Measurement  
Rutgers, The State University of New Jersey

### ABSTRACT

Although many early adaptive testing methodologies in the literature are based upon unidimensional item response theory (IRT) models, these methodologies have been generalized to or adjusted for multidimensional cases. Along with the developments on the multidimensional adaptive testing, cognitive diagnosis modeling has also shown rapid development over the past decades. Despite its novelty, researchers have already conducted studies to manage to implement cognitive diagnosis computerized adaptive testing (CD-CAT). Following these developments, this manuscript aims to compile and highlight the developments in multidimensional computerized adaptive testing and review the advances in the CD-CAT development.

### INTRODUCTION

Test administration process may be categorized as (a) individually or (b) group administered with respect to type of administration. Both types have some advantages and disadvantages such as the advantage of uniformity of test situation and vastly reduced cost of mass-administered tests. However, a mass-administered test must take into account the assumption that the examinee ability range is broad. Therefore, in order to effectively measure all examinees' ability levels, the test should be consisted of items with varying difficulty levels (i.e., easy-moderate-hard) so that test difficulty matches examinee group.

Computerized adaptive testing (CAT), however, selects and administers items that are most informative with respect to the current ability estimate. Meijer and Nering (1999) stated the objective of CAT as the attempt to construct an optimal test for each examinee based on his/her ability level. Therefore, it reduces the possibility of administering an item which is too far from examinee's ability level. To achieve this goal, an item is selected from an item pool consisting of items with various difficulty levels for administration based on examinee's responses to the previous items. This item administration procedure continues until a stopping rule (e.g., reaching to a predetermined number of items or threshold for standard error of the estimate) is satisfied.

Although many early adaptive testing methodologies in the literature are based on unidimensional item response theory (IRT) models, these methodologies have been recently generalized to or adjusted for multidimensional cases. Another measurement and assessment related subject that has shown rapid development over the past decade is the cognitive diagnosis models (CDMs). These models are used to extract diagnostic information from cognitively diagnostic assessments (CDAs; de la Torre & Minchen, 2014). CDMs are used to classify examinees one of the latent classes, which are characterized by a  $K$  number of discretely defined cognitive competencies, skills, and strategies. A latent class in which examinee is assigned to shows the examinee's attribute profiles in terms of mastery or nonmastery status of attributes. Despite its novelty, researchers have been conducting research to manage to implement cognitive diagnosis computerized adaptive testing (CD-CAT).

Following these developments, this paper aims to (1) compile and highlight the developments in multidimensional computerized adaptive testing (MAT), and (2) review the advances in the CD-CAT development. This study provides an overview of recent developments in adaptive testing with an expectation of providing researchers and practitioners with pragmatic information. The rest of the manuscript is organized as following: The next section will briefly explain the CDM framework. Then, adaptive testing system components and the developments within them will be reviewed. Finally, a discussion section will conclude the manuscript.

### COGNITIVE DIAGNOSIS MODELS

In psychometric literature, a generic term *attribute* is used to refer to target discrete skills and strategies to be measured (de la Torre, 2009). Based on examinee's observed responses, CDMs assign each examinee a vector that shows mastery and nonmastery of measured attributes. This vector is typically binary where 1 and 0 indicate presence or absence of each of  $K$  attributes, respectively. Although the types and psychometric properties of

CDMs are not in the scope of this paper, it should be noted that various reduced and general CDMs have been recently developed. A broad discussion on these models can be found in Rupp and Templin (2008), and de la Torre (2011).

Most, if not all, CDMs utilize an item-by-attribute matrix, which is referred to as Q-matrix (Tatsuoka, 1985). This matrix specifies the association between the items and attributes. Each row of the matrix corresponds to an item that indicates the necessary attributes for successful completion of the item. For attributes  $k=1\dots K$  and items  $j=1\dots J$  in a test (or more generally in an item bank for CAT), the Q-matrix element  $q_{jk}$  is defined as

$$q_{jk} = \begin{cases} 1, & \text{if item } j \text{ requires attribute } k \\ 0, & \text{otherwise} \end{cases}$$

For instance, when  $K=3$ , if  $j$ th item requires the first and the third attributes, then the  $j$ th row of the Q-matrix becomes  $\{1,0,1\}$ .

Furthermore, a test measuring  $K$  attributes partitions latent space into a total of  $2^K$  latent classes. For example, when  $K=3$ ,  $2^3=8$  latent classes possible (i.e.,  $\{0,0,0\}$ ,  $\{1,0,0\}$ ,  $\{0,1,0\}$ ,  $\{0,0,1\}$ ,  $\{1,1,0\}$ ,  $\{1,0,1\}$ ,  $\{0,1,1\}$ , and  $\{1,1,1\}$ ). By employing an appropriate CDM, each examinee is assigned to one of these latent groups where the group labels become examinees' attribute profiles. When examinee  $i$  is classified to the latent class  $\{1,1,0\}$ ; it implies that examinee  $i$  has mastered the first and the second attributes but not the third one.

## DEVELOPMENTS IN ADAPTIVE TESTING SYSTEMS

### Item Pool

A calibrated item pool is a collection of test items with their item parameters stored in a computer-media (Reckase, 2009). In adaptive test environment, individualized tests are introduced to examinees, which require composition of many different forms of the same test. Flaugher (2000) stated that adaptive algorithm can do better job as the quality of the item pool increases. Flaugher (2000) and Reckase (2009) pointed out that the best and the most sophisticated adaptive testing procedure would not perform well if the quality of items in the pool is poor or items in the pool are not appropriate for target population. Therefore, not only size of an item pool but also characteristics of items within the pool are among the important considerations.

In adaptive testing systems two types of parameter estimations are identified. These distinct types are *initial calibration* and *on-line calibration*. In the former, responses are solicited from examinees only for not yet calibrated items. In the latter type of calibration, examinees give responses to both new and previously calibrated items during the adaptive test administration. According to Wainer and Mislevy (2000), *initial calibration* may be required for situations where (1) a novice test is being developed, and (2) an existing conventional test being adapted to a CAT. However, Wainer and Mislevy (2000) pointed out that, when an existing conventional test is adapted to CAT, an equating step might be required to adjust the item parameters for presentation effect (effect of testing format).

One of the issues with CAT is controlling item exposure rates. Overused items need to be replaced with new items; therefore, the parameters of the new items must be obtained in the established scale. Thus, *on-line calibration* needs to be considered if the parameters of new items need to be estimated within testing process by introducing new items along with the calibrated items (Wainer & Mislevy, 2000). One way of on-line calibration is to carry out a large, independent, calibration study with some linking items. In this method, one needs to find a linear transformation of new calibration, which matches up to the pre-and post-estimation of linking items. Then, this linear transformation can be used to bring the new items onto the existing scale.

For the item calibration process, expectation-maximization (EM) algorithm (Dempster, Laird, & Rubin, 1977) is a common approach for both IRT and CDM. Many existing commercial and freeware software programs employ EM algorithm for item calibration due to its computation efficiency (see Rupp and Templin (2008) for a list of software programs that can be used for CDM estimation). A practical issue for item calibration using EM algorithm is the required sample size. De Ayala (2009) argued that based on the research on IRT parameter estimates, 1000 individuals were enough for accurate and precise item parameter estimates via marginalized maximum likelihood estimation (p. 130).

In diagnosis model estimations, required sample size for accurate calibration depends on the specific CDM and number of attributes measured in a test. For example, regardless of the number of attributes measured, the deterministic input, noisy and "gate" (DINA: Junker & Sijtsma, 2001) model allows only two item parameters,

whereas, the generalized-DINA (de la Torre, 2011) model specifies  $2^{K_j}$  item parameters to be estimated, where  $K_j$  shows the number of required attribute by item  $j$ . For example, if  $j$ th item requires four attributes, 16 item parameters need to be estimated for that item. Although Rupp and Templin (2008) claimed that a couple of hundreds examinees per item were sufficient for simplest models such as DINA; there is not enough research on the systematic investigation of the relationships between minimum required sample size, types of CDMs, and number of attributes measured by a test.

### Item Selection Rule

To build and carry out an efficient CAT, the most informative item should be selected based on the examinee's the most recent ability estimate. This fact gives rise to use of a number of efficient and practical item selection algorithms. The goal of most IRT based CAT is to select a subset of items that provide sufficient information to accurately locate the examinee within the ability space. Similarly, CD-CAT aims to select a subset of items that provide sufficient information to accurately classify examinees into latent classes. Therefore one of the essential components of adaptive testing is a mechanism for selecting items from the item pool. This item selection procedure (to select  $m^{th}$  item) is applied in real time depending on the information available about the examinee's ability after applying  $m-1$  items. Item selection rules for unidimensional-CAT have been generalized to multidimensional cases.

The *Fisher information* is a common method for measuring the amount of information carried by observable variables about an unknown parameter. In multidimensional cases, the Fisher information matrix is considered as a convenient measure. For item  $j$ , the information matrix is defined as

$$I_j(\theta) \equiv -E \frac{\partial^2}{\partial \theta^2} \ln f(X_j | \theta) = \frac{Q_j(\theta)(P_j(\theta) - \gamma_j)^2}{P_j(\theta)(1 - \gamma_j)^2} \alpha_j \alpha_j' \quad (1)$$

where,  $\theta$  is the multidimensional ability vector,  $P_j(\theta)$  is the probability correct response to item  $j$ ,  $Q_j(\theta) = 1 - P_j(\theta)$ ,  $\gamma_j$  is the guessing parameter, and  $\alpha_j'$  is the transpose of the vector of discrimination parameters in a multidimensional three parameter logistic model.

Because of the additivity property of the Fisher information, the information matrix of a set of  $S$  items is obtained by summing the item information matrices,

$$I_S(\theta) = \sum I_j(\theta). \quad (2)$$

Once the  $\theta$  is substituted by its estimate,  $\hat{\theta}$ , in the equation 2, an estimate of item and test information matrices are obtained. Thus, in the process of selecting the  $m^{th}$  item, after administering  $m-1$  items, the amount of information to be maximized is expressed as

$$I_S^{(m-1)}(\hat{\theta}^{(m-1)}) + I(\hat{\theta}^{(m)}). \quad (3)$$

Then an item selection algorithm based on the Fisher information selects an item (i.e.,  $m^{th}$  item) such that  $I_S^{(m)}(\hat{\theta}^{(m)})$  is the largest.

Segall (1996) introduced a new item selection approach for MAT (i.e., maximizing the determinant of the fisher information matrix) based on the relationship between the Fisher information matrix and the confidence region around the estimates. Segall (1996) emphasized that when

$$\det | I(\hat{\theta}^{(m-1)}) + I(X^{(m)}) | \quad (4)$$

is maximized, the volume of the confidence ellipsoid is minimized. In equation 4, the term on the left is the test information matrix for  $m-1$  administered items; and the term on the right is the item information matrix obtained by administering item  $m$ . The purpose of this rule is to select the next item that has an item information matrix that results in the maximum value for the determinant of the sum.

Segall (1996) specified another approach referred to as largest decrement in the volume of the Bayesian credibility ellipsoid. This approach is connected to Bayesian modal approach used for ability estimation. The goal of this method is selecting a candidate item that results in the largest decrease in the volume of the Bayesian credibility ellipsoid for ability estimation. As reported in Reckase (2009), Segall (1996) assumed that the prior distribution for the  $\theta$ -space was multivariate normal with variance-covariance matrix  $\Phi$ . Based on this assumption; he claimed that the volume of the Bayesian credibility ellipsoid for the estimate of  $\theta$  becomes

$$\det | \mathbf{I}(\hat{\boldsymbol{\theta}}^{(m-1)}) + \mathbf{I}(X^{(m)}) + \Phi^{-1} |. \quad (5)$$

Once this expression is maximized, the volume of the credibility ellipsoid is minimized.

Veldkamp and van der Linden (2002) adapted Kullback-Leibler (KL) information for item selection in multidimensional adaptive testing. KL information is a non-symmetric distance measure to account for divergence between two probability distributions (Cover & Thomas, 1991). It should be noted here that Chang and Ying (1996) have used the KL information for the unidimensional-CAT. For a binary item response  $X_j$  and true examinee ability vector  $\boldsymbol{\theta}_0$ , KL information for item  $j$  is defined as

$$K_j(\boldsymbol{\theta}_0, \boldsymbol{\theta}) = E \left[ \ln \frac{L(\boldsymbol{\theta}_0 | X_j)}{L(\boldsymbol{\theta} | X_j)} \right] \quad (6)$$

where  $\boldsymbol{\theta}$  is another possible ability vector and  $L$  is the likelihood function  $P_j(\boldsymbol{\theta})^{X_j} Q_j(\boldsymbol{\theta})^{(1-X_j)}$ . Veldkamp and van der Linden (2002) showed that the KL information is additive such that information provided by individual items are summed to obtain KL for a total of  $m$  administered items. Therefore, Veldkamp and van der Linden (2002) suggested selecting an item that maximizes the posterior expected KL information. It has been shown that item selection based on KL information outperforms to traditional Fisher information (Reckase, 2009; Veldkamp & van der Linden, 2002).

Due to the fact that latent variables being measured in CDMs are discrete, Fisher information related item selection rules cannot applied to CD-CAT as they require continuous latent variables (Xu, Chang, & Douglas, 2003). Alternatively, Xu et al. (2003) have suggested using KL information and Shannon entropy (SHE) for CD-CAT item selection. KL information for CD-CAT was defined as

$$KL_{j(\hat{\alpha}_i)} = \sum_{l=1}^{2^K} \left[ \sum_{x=0}^1 \log \left( \frac{P(X_j = x | \hat{\alpha}_i)}{P(X_j = x | \alpha_l)} \right) P(X_j = x | \hat{\alpha}_i) \right] \quad (7)$$

where  $l=1, \dots, 2^K$  possible latent classes defined by  $K$  attributes,  $P(X_j = x | \hat{\alpha}_i)$  is the probability of correct response of examinee  $i$  to item  $j$  given the examinee's current attribute profile estimate  $\hat{\alpha}_i$ , and  $\alpha_l$  is attribute profile other than  $\hat{\alpha}_i$ .

SHE is a measure of uncertainty in probability distributions (Cheng, 2009), which can be considered as the measure of flatness of posterior distribution of latent classes in CDM. The item selection rule specified in Xu et al. (2003) is based on the minimization of expected SHE of the posterior distribution of  $\hat{\alpha}$ . Xu et al. reported that, in comparison with KL, SHE required more computation time than KL; yet it was more efficient in terms of classification accuracy. Although both SHE and KL information based item selection rules were reported to be promising, Cheng (2009) achieved higher classification accuracy by modifying KL item selection rule in CD-CAT. She proposed a rule based on posterior weighted KL (PWKL)

$$PWKL_{j(\hat{\alpha}_i^{(m)})} = \sum_{l=1}^{2^K} \left[ \sum_{x=0}^1 \log \left( \frac{P(X_j = x | \hat{\alpha}_i^{(m)})}{P(X_j = x | \alpha_l)} \right) P(X_j = x | \hat{\alpha}_i^{(m)}) \pi_i^{(m)}(\alpha_l) \right] \quad (8)$$

where  $P(X_j = x | \alpha_l)$  is the probability correct response of the item  $j$  given the attribute profile  $\alpha_l$ ,  $\pi_i^{(m)}(\alpha_l)$  is the posterior probability of examinee  $i$  at iteration  $m$  (i.e., after administering  $m$  items). Posterior probability of examinee  $i$  after administering  $m$  items is

$$\pi_i^{(m)}(\alpha_l) \propto \pi_i^{(0)}(\alpha_l) L(X_i^{(m)} | \alpha_l) \quad (9)$$

where  $\pi_i^{(0)}(\alpha_l)$  is the current prior (e.g., the prior at the beginning of the test administration or posterior after administering  $m-1$  items) and  $L(X_i^{(m)} | \alpha_l)$  is the likelihood of examinee  $i$ 's response vector  $X_i^{(m)}$  given the attribute profile  $\alpha_l$ . Her results showed that the PWKL yielded higher correct classification rates in comparison to the KL and SHE methods.



Lately, Kaplan, de la Torre, and Barrada (2015) argued that, by using the current estimate  $\hat{\alpha}_i^{(m)}$ , PWKL assumes that the point estimate is a good summary of posterior distribution  $\pi_i^{(m)}(\alpha_l)$  and this assumption might not hold, especially in the early stages of testing. Therefore they proposed a modified version of the index, which is referred to as modified posterior weighted Kullback-Leibler (MPWKL). In the formulation of this item selection index, they consider posterior probabilities for all  $2^K$  attribute profiles. MPWKL is formulated as

$$MPWKL_{ij}^{(m)} = \sum_{d=1}^{2^K} \left[ \sum_{l=1}^{2^K} \left[ \sum_{x=0}^1 \log \left( \frac{P(X_j = x | \alpha_d)}{P(X_j = x | \alpha_l)} \right) P(X_j = x | \alpha_d) \pi_i^{(m)}(\alpha_l) \right] \pi_i^{(m)}(\alpha_d) \right], \quad (10)$$

which does not require current estimate of attribute profile (i.e.,  $\alpha_i^{(m)}$ ), rather, it considers the entire posterior distribution and weights them accordingly. It is clear from the formulation that this procedure requires an extra summation in comparison with the PWKL that makes estimation computationally cumbersome when  $K$  is large. However, Kaplan et al. (2015) reported that MPWKL provides higher correct classification rates in comparison to the PWKL.

Kaplan et al. (2015) has proposed another item selection rule using the G-DINA model discrimination index (GDI), which was proposed by de la Torre and Chiu (2010, 2015) as an index for empirical Q-matrix validation. The GDI, denoted as  $\zeta_j^2$ , is a measure of weighted variance of the success probabilities of an item given an attribute profile distribution (Kaplan et al., 2015). To define the index, let  $\kappa_j^*$  be the number of set of attributes required by item  $j$ ; and  $\alpha_{ij}^*$  be the reduced set of attribute profiles formed by  $\kappa_j^*$  attributes such that  $l = 1, 2, \dots, \kappa_j^*$ . Then,  $\zeta_j^2$  is defined as

$$\zeta_j^2 = \sum_{l=1}^{2^{\kappa_j^*}} [P(X_{ij} = 1 | \alpha_{ij}^*) - \bar{P}_j]^2 \pi_i^{(m)}(\alpha_l) \quad (11)$$

where  $P(X_{ij} = 1 | \alpha_{ij}^*)$  is the probability correct on item  $j$  given the reduced attribute profile,  $\bar{P}_j$  is the mean success probability calculated as,  $\sum_{l=1}^{2^{\kappa_j^*}} \pi(\alpha_{ij}^*) P(X_{ij} = 1 | \alpha_{ij}^*)$  and  $\pi_i^{(m)}(\alpha_l)$  is the posterior probability of examinee  $i$  after administering  $m$  items.

Kaplan et al. (2015) emphasized the fact that GDI considers only the reduced attribute profiles, which makes it computationally more efficient (i.e., when  $K = 6$  and  $\kappa_j^* = 2$ , GDI computation is based on  $2^2 = 4$  latent classes rather than  $2^6 = 64$ ) in comparison to PWKL and MPWKL. Their simulation studies showed that both MPWKL and GDI item selection algorithms resulted in very similar classification rates, which were, in general, higher than the ones obtained through the PWKL as an item selection rule.

### Item Exposure Rate and Overlap Rate

One of the vital practical considerations in adaptive testing is the test security. Either organized or individual item theft may seriously damage a high-stake and large-scale adaptive testing program. The features such as flexibility of examination times and testing on demand allow an examinee to communicate with other examinees about the topics and the items administered to them. Lee, Ip, and Fuh (2008) argued that because item selection algorithms tend to select optimal items, they often choose the most discriminating items, which are in return used more often than others. They further stated that this overexposure of some specific items might lead to information sharing among the examinees. Then, these overexposed items will eventually be public knowledge and will be answered by all examinees regardless of their ability levels.

The ratio between the number of times an item is administered and total number of examinees is called *item exposure rate*. According to Revuelta and Ponsoda (1998), item exposure rate depends on three elements of the measurement process which are; (a) psychometric properties of the items, (b) items available in the item pool, and (c) the ability distribution of the examinees. They further stated that the strategies for controlling item exposure rate have two substantial goals; (1) preventing overexposure, and (2) increasing the use of infrequently or never-selected items. Although substantial number of research on item exposure rate control conducted thus far (i.e., McBride & Martin, 1983; Symphon&Hetter, 1985; Hetter&Symphon, 1997; Stocking & Lewis, 1998; van der

Linden & Reese, 1998; Chang & Ying, 1999; van der Linden, 2003; Boyd, Dodd & Fitzpatrick, 2003); Yi, Zang, and Chang (2008) claimed that the Sympon-Hetter (SH) and Stocking-Lewis (SL) exposure control procedures are commonly used for traditional CAT.

Let the size of the item pool be  $J$  and let the test length be  $n$ . Ideally, all the items in the item pool are expected to have the same exposure rate, which is calculated as

$$\overline{er} = \frac{n}{J}. \tag{12}$$

However, in applications, because of the psychometric characteristics of the items, some items are more likely to be administered. This disparity in item selection ratio produces an asymmetric item exposure rate distribution. In order to measure this asymmetry, Chang and Ying (1999) proposed a  $\chi^2$  distribution:

$$\chi^2 = \sum_{j=1}^J \frac{(er_j - \overline{er})^2}{\overline{er}}, \tag{13}$$

A low  $\chi^2$  value represents a low discrepancy between observed and ideal exposure rates (Lee et al. 2008). It should be noticed here that constraint on item exposure comes at a price. As Finkelman, Nering, and Roussos (2009) argued, all item exposure methods result in a reduction in psychometric precision. So, there is a trade-off between item exposure control and measurement precision. Although a good number of researches had performed to introduce item exposure rate control methods, there exist relatively few studies considering MAT and CD-CAT.

A series of studies proposed methods for item exposure control in unidimensional CAT. One of the popular exposure control methods was proposed by Sympon and Hetter (1985) which is an iterative procedure for controlling item exposure. To define the method, let  $P(A)$  be the probability of administering an item and let  $P(S)$  be the probability of selection an item. In this case, selecting an item does not mean to administer the item for sure. In the Sympon and Hetter (SH) method, an item exposure parameter, the probability of administering an item that had already been selected  $P(A|S)$ , is assigned to each item. If the parameter of a particular item is higher than the prespecified exposure rate, the item cannot be administered when it is selected. However, the main drawbacks of this method involved time-consuming iterations in calculating item exposure parameters and not being able to maintain the exposure rates of all items at or below the prespecified desired exposure rate (Barrada, Abad, & Veldkamp, 2009). Later Finkelman et al. (2009) proposed the *Generalized Sympon-Hetter Method*, which combines the SH exposure control method and *Kullback-Leibler* ( $KL_j^{(m-1)}$ ) index, which is

$$KL_j^{(m-1)} \equiv \int_0^1 K_j(\hat{\theta}^{(m-1)}, \theta) f^{(m-1)}(\theta) d(\theta), \tag{14}$$

where  $K_j(\hat{\theta}^{(m-1)}, \theta)$  is defined in equation 6,  $f^{(m-1)}(\theta)$  is the posterior density of  $\theta$  after  $m-1$  items. The overall goal of this method is to keep administration rate below a prespecified *desired exposure rate* ( $r$ ). Let  $A$  to be the administration, and  $\pi_{j, f_0(\theta)}(A)$  the probability of administering item  $j$  with respect to the prior distribution  $f_0(\theta)$ . Then, the method sets a relation

$$\pi_{j, f_0(\theta)}(A) \leq r \tag{15}$$

for all  $j$ . To succeed in keeping the *inequality 15*, items are initially ranked based on some psychometric criterion (e.g., based on  $KL_j^{(m-1)}$ ) and the item maximizing  $KL_j^{(m-1)}$  becomes a *candidate* item, which is administered with a conditional probability of  $P_j(A/S)$ , where  $A$  and  $S$  indicate the number of administration and number of selection, respectively. The algorithm searches for a new candidate item, as the current candidate item is not allowed for administration. This process is carried on until a candidate is approved for administration.

In general, SH method requires computation of  $P_j(S)$  and  $P_j(A)$ , which can be carried out regardless of the dimensionality of the psychometric criterion for item selection. Thus, the SH method is applicable to both unidimensional and multidimensional cases. However, according to Finkelman et al. (2009), there are two substantial differences; (1) a multivariate prior distribution must be used to generate the abilities for simulees in MAT to set threshold  $r$  and (2) the psychometric index differs for these two cases which means that although the Fisher information can be used in unidimensional-CAT item selection algorithm; multidimensional item selection indices have to be employed in MAT.

Security can be an issue with one of the two ways: (1) item theft by an organized group and (2) peer-to-peer communication. Stocking-Lewis (1998) pointed out that if the test security threat of peer-to-peer communication is

of concern, examinees with similar abilities are most likely to share information about the contents and items of a test. Consequently, it requires exposure control conditional on ability. They presented a method to control exposure rate conditional upon examinee ability level (i.e., Stocking-Lewis [SL]). This method is applicable for unidimensional CAT procedures. Later, for multidimensional cases, Finkelman et al. (2009) introduced a generalized version of SL method known as generalized Stocking-Lewis (GSL) method.

The SL method sets the exposure control boundary along a set of  $U$  discrete  $\theta$ -levels,  $\theta_1, \dots, \theta_U$ , which approximately satisfies the boundary for all ability levels. Notice that the constraint is not implemented over all ability levels, it rather is implemented over  $U$  meaningfully selected values of  $\theta$ . Therefore, this method establishes the relation below for all  $j$  and all  $u = 1, \dots, U$ ,

$$\pi_{j, \theta_u}(A) \leq r \tag{16}$$

Inequality 16 is used as surrogate for the desired relation of

$$\pi_{j, \theta}(A) \leq r. \tag{17}$$

The computed proportion of selection and administration for each  $\theta_u$  are then denoted as  $P_{j, \theta_u}(S)$  and  $P_{j, \theta_u}(A)$ , respectively. When item  $j$  is selected as a candidate item, the item exposure control parameter  $P_{j, \theta_u}(A|S)$  that corresponds to  $\theta_u$  is used as it is closest to the current theta estimate.

In multidimensional cases, direct extension of SL method would require inequality 16 for all  $j$  and all  $u$  over an  $D$ -dimensional grid where ability is represented by a vector  $\theta$  ( $\theta_1, \dots, \theta_D$ ). Finkelman et al. (2009) discussed that because the number of  $\theta$  values requiring inequality 16 exponentially increases as the number of dimensions increases, complete crossing of discrete values in the grid is intractable even when  $D$  is moderate. The GSL method proposed by Finkelman et al. (2009), ideally, maintains a good number of quadrature points regardless of  $D$ . Instead of using inequality 16, this method performs an exposure control conditional on  $\theta^*$ , where  $\theta^*$  is considered to be a function of  $\theta$ . However  $\theta^*$  is a scalar such that  $\theta^* = \lambda' \theta$  where  $\lambda$  is a set of weights. Therefore, item exposure control is conditional on a linear combination of  $D$  dimensions of  $\theta$ . Then the established relationship between probability of administering item  $j$  at  $\theta^*$  and desired exposure rate is

$$\pi_{j, \theta^*}(A) \leq r, \tag{18}$$

for all  $j$  and all values  $\theta^*$ . All operational steps are same for SL and GSL methods, the only difference is that the conditioning variable in GSL becomes  $\theta^*$  rather than  $\theta$ .

For item exposure control in the context of cognitive diagnosis, Wang, Chang, and Huebner (2011) proposed a restrictive stochastic item selection method, which is a modified version of the progressive method (PM; Revuelta, 1995) for traditional CAT procedures. The PM method weights items based on an information component with a random part, where as the test progresses the relative impact of information increases. Wang et al. (2011) modified the PM by adding a stochastic component such that it would not always select the item producing the highest information at the current stage. The restrictive progressive (RP) method that employs PWKL information is defined as

$$RP - PWKL_j = \left(1 - \frac{exp_j}{r}\right) \left[ \left(1 - \frac{m-1}{n}\right) R_j + \frac{PWKL_j \beta_{(m-1)}}{n} \right], \tag{19}$$

where  $exp_j$  is the preliminary exposure rate of item  $j$ ,  $r$  is the pre-defined exposure control rate,  $m-1$  is the number of administered items,  $n$  is the test length,  $R_j$  is a random value that is drawn from a uniform distribution between 0 and  $PWKL_j$  for the items in the pool, and  $\beta$  is an arbitrary number to control the balance between the test security and estimation accuracy. Smaller  $\beta$  tends to produce more secure test, however, tests with small  $\beta$  yield less accurate estimation.

Kaplan (2016) has recently incorporated the RP method for exposure control with the GDI and MPWKL item selection rules for CD-CAT application. The notation below is the RP method representation where  $\Delta_j$  indicates the information on item  $j$  (e.g.,  $MPWKL_j$  and  $\zeta_j$ )

$$RP - \Delta_j = \left(1 - \frac{exp_j}{r}\right) \left[ \left(1 - \frac{m-1}{n}\right) R_j + \frac{\Delta_j \beta_{(m-1)}}{n} \right], \tag{20}$$

Notice that the current form of RP method is applicable to fixed length (i.e.,  $n$ ) tests. In his study, Kaplan (2016) modified it such that minimum of the maximum of the posterior distribution is used as the test termination rule. Then, the modified item selection index incorporating the RP method is

$$RP - \Delta_j = \left(1 - \frac{\exp_j}{r}\right) \left[ f(x)R_j + \Delta_j \beta \frac{\pi(\hat{\alpha}_l | X_j)}{P} \right], \quad (21)$$

Where  $f(x) = \min\left(0, 1 - \frac{\pi(\hat{\alpha}_l | X_j)}{P}\right)$  and  $P$  is the predetermined minimax value.

### Stopping Rule

A rule determining when to stop administering items adaptively is referred to as *stopping rule*. Stopping rules can be set for fixed- and variable-length tests (Reckase, 2009; Frey & Seitz, 2009). A stopping rule for a fixed-length test sets a predetermined number for item administration. Once the test reaches this pre-specified length, it is terminated and final ability estimate is computed. A variable-length test is terminated based on a pre-specified standard error of the ability estimate. In other words, stopping rule in a variable-length test becomes a statistical criterion on the measurement precision. In variable-length tests, the number of items to be administered depends on the location of the examinee in the latent ability-space, consistency of examinee responses, and the information provided by the item pool relative to the ability level (Reckase, 2009) or his/her attribute profile in CDM cases.

Reckase (2009) argued that test length could be determined based on some practical considerations such as testing time, or by taking the average of the variable length tests. Wang, Chang, and Boughton (2012) argued that the literature on MAT focuses on the stopping rules for fixed-length tests, which provide less accurate ability estimates for examinees whose ability locations are substantially different than the average difficulty level of the item bank.

Despite the fact that fixed- and variable-length stopping rules were well explored in the unidimensional CAT, Wang et al. (2012) noted that because the precision of multiple ability dimensions should be considered simultaneously, these well-defined stopping rules cannot straightforwardly be generalized to multidimensional adaptive testing situations. They further discussed that in order to set a stopping criterion for MAT, firstly, an index such as generalized variance, total variance, or entropy should be set to quantify the estimation accuracy of  $\theta$ -vector. Moreover, Kaplan and de la Torre (in press) is among the limited variable-length CD-CAT studies where they use the minimum of the maximum of the posterior distribution as the test termination rule.

### DISCUSSION

This paper intended to compile and highlight the recent developments in CAT procedures by reviewing the generalization and/or modification of traditional CAT components for MAT and CD-CAT applications. This paper also intended to provide researchers and practitioners with pragmatic information such that they can use this information toward their own research and application purposes.

When traditional CAT is intended, unidimensional items need to be written and calibrated in accordance with unidimensional IRT models. Similarly, item development and item calibration need to be in accordance with the MIRT models when MAT is intended. Item pool development for CD-CAT can be much more challenging, as CDM applications require a Q-matrix specifying the item-by-attribute associations. Construction of a Q-matrix requires collaboration among measurement experts and content experts. The misspecification of the Q-matrix can reduce the credibility of CD-CAT applications.

Generalization of traditional CAT procedures for MAT is challenging because the new procedures needs to be tractable and computationally manageable as the number of dimensions increases. Further, due to the discrete nature of CDMs, not all conventional item selection rules and exposure control rates can be modified for CD-CAT implementations. For example, item selection algorithms based on Fisher information cannot be applied in the context of cognitive diagnosis (Xu, Chang, & Douglas, 2003). Alternatively, the MPWKL and GDI can be used as item selection algorithms in CD-CAT.

Another vital practical consideration in adaptive testing is item exposure rates. It should be noticed that constraints on item exposure comes at a price because item selection algorithms can no longer use the most informative items in every step. As discussed by Finkelman, Nering, and Roussos (2009), employment of item exposure control methods on the item selection algorithms results in reduction in estimation accuracy. In other words, there is a trade-off between item exposure control and measurement precision. There is not much research conducted for item exposure control in CD-CAT applications. Wang, Chang, and Huebner (2011) proposed a restrictive progressive item selection method, which is a modified version of PM (Revuelta, 1995; Revuelta & Ponsoda, 1998) for traditional CAT applications. Although the RP was proposed for and used with fixed-length tests, it was recently modified for variable-length tests.

Another practical consideration in adaptive testing is the starting point (i.e., with which item to start), for which there is not enough research for CD-CAT. Similarly, impact of type of attribute profile estimation (i.e., MLE, MAP, and EAP) may impact item selection and consequently exposure rates differently. Impact of ability estimation methods and the prior distribution on CD-CAT can be further research topics.

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