

CONTEXTS AND PROCESSES FOR THE DEVELOPMENT OF CONTENT TESTS TO ASSESS TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE

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Abstract: Pedagogical content knowledge (PCK) and content knowledge (CK) are considered key components that affect student success and teaching-learning transactions in the classroom. Recently, the Department of Education in the Philippines underwent crucial steps towards improving education in the country. With the enactment into law and full implementation of the K to 12 reform in the primary and secondary education, the country's education sector faces the crucial time to assess what the teachers know and can do in order to determine their professional development needs to implement the new curriculum. To date, there have been few large scales studies in the Philippines to determine teachers' preparedness to undertake curriculum reform. To address this, content tests based on the new curriculum were developed. The process undertaken in the development of these content tests is discussed in this paper. Further, the paper also offers insights into the theoretical framework used for the development of content tests as an assessment tool and on the importance of determining teachers' PCK as an integral component of enhancing teacher quality. Finally, recommendations for further development of the content test and on their use are discussed.

Key words: PCK, teacher quality, assessment of PCK, test development, curriculum reform

Introduction

The Philippines is an archipelago in South-East Asia. With a projected population of over 96 million inhabiting its 7,100 islands, the country faces challenges amidst international repositioning in the areas of economy, politics and education. Its education sector, for instance, is manned by an estimated 500,000 teachers supervised by one agency, the Department of Education (DepEd) with the head office based in Manila. DepEd faces challenges like shortage of classrooms and other infrastructure, insufficient textbooks, consistent decline in the performance of learners in national assessment, among others. There is also a growing concern over quality of teachers. The government continues to find ways to address these many challenges. Of late, DepEd initiated reforms that aim to address pressing concerns; foremost of this is the implementation of the K to 12 reform.

The enactment into law of the K to 12 curricular reform changes the landscape of education in the country by adding 2 years to the 10 years for primary and secondary education. The 12 year primary and secondary education is patterned after the curriculum of all countries in the ASEAN region and the world. Reports show that only Philippines, Angola and Djibouti have 10-year basis schooling system (news.inquirer.net; <http://www.seameo.org/vl/library/DLWelcome/Publications/paper/india04.htm>). The move is also in consonance with the launching of ASEAN 2015 which integrates, among others, the educational policies of member nations. The integration for education, for instance, establishes a system of equivalency of courses taken by students in any ASEAN countries.

The K to 12 curriculum, other than a response to the ASEAN 2015 is seen by the Philippine government as "designed to address the poor quality of basic education" (<http://www.deped.gov.ph/k-to-12/About/features>). The law enacts several reforms and has the following salient features:

- a. Strengthening early childhood education or the Universal Kindergarten
- b. Making the curriculum relevant to learners (contextualization and Enhancement)
- c. Ensuing integrated and seamless learning or the spiral progression
- d. Building proficiency through mother tongue based multilingual education
- e. Nurturing the holistically developed Filipino or the College and Livelihood Readiness

(<http://www.deped.gov.ph/k-to-12/About/features>)

More than ever, the Philippine education moves towards giving ‘a stronger foundation for the next generation’ (<http://www.philstar.com/opinion/2014/07/30/1351852/lets-push-k-12-program>) Viewed from this perspective, the K to 12 reform enables the country’s education group to mobilize all sectors of the society for its successful implementation. This initiative paved the way for the Department of Education to address the critical demand for effectiveness in all areas of the reform: curriculum and instruction, teachers, additional classroom and other infrastructure and system upgrade. Such demand for strengthening effectiveness is the country’s open response to the global perspective that expansion in education, as documented in most countries in the world, has its link to the development of work force (Symaco, 2013.) For developing countries, like the Philippines, education development is even considered as indispensable for national development.

The development of content tests is part of one of the major research projects of the Philippine National Research Center for Teacher Quality (RCTQ) based at the Philippine Normal University, the country’s National Center for Teacher Education. The Center is established mainly to support the implementation of the K to 12 reform and is funded by the Department of Foreign Affairs and Trade (DFAT) of the Australian Government.

Teacher Quality

Many studies point to teacher quality as the most important gauge in determining success of educational policies. To Darling Hammond (2006), the quality of teachers remains to be the most important determiner of student outcome. In fact, teachers have more impact on student learning than any other factor controlled by the school system (Rivkin, Hanushek and Kain, 2005).

Teacher quality is often measured using common indicators: teacher experience, possession of graduate degrees, and teacher certification (Jacob, 2012). In the Philippines, teacher quality is defined by DepEd’s document called National Competency-based teacher Standards (NCBTS) that was developed in 2006. This set of standards is a self-assessment tool measuring the competence of teachers in the delivery of content knowledge and pedagogical content knowledge. International studies account for the importance of teacher quality as the most important variable in influencing student achievement. Again in the words of Darling-Hammond (2006), it is imperative to measure teachers’ ability to deliver their field of specialization. While it is a nationally accepted assessment tool on teachers’ knowledge, NCBTS could not gauge other indicators of teacher quality like student performance or achievement. In the OECD report (2005), one important examination was done on students’ performance, through standardized tests, to assess teacher performance. The report indicates that the correlation between the two variables, it does not fully define teacher quality, however, but it certainly reflects comparisons.

The need to assess the teachers’ ‘actual’ knowledge based on the current curriculum is leading to understanding teacher competence. Competence is best described as ‘complex combination of knowledge, skills, understanding, values, attitudes and desires which lead to effective, embodied human action in the world, in a particular domain’ (Hoskins, et al., 2008). This paper underscores the importance, if not relevance, of relying on an objective assessment tool, such as content test, to assess what teachers ‘actually know’.

Pedagogical Content Knowledge

First introduced by Lee Shulman in 1986, pedagogical content knowledge (PCK) is described as “comprising an understanding of the content being taught, a mastery of the illustrations, examples and explanations that best support students’ learning; and an understanding of what makes learning the content easy or difficult for students of different ages and backgrounds” (cited in MET report, 2010). Shulman further posits that pedagogical content knowledge is a form of practical knowledge that is utilized by teachers which help guide their actions and decisions in the classroom. Simply put, PCK is what teachers bring to the classroom, which mainly affect student learning.

Studies on PCK further account for the need to know the PCK knowledge of teachers. Krauss, et al. (2008) posited the need for teachers to have deep knowledge of how to teach their specific subject for effective practice while Williamson McDiarmid & Clevenger-Bright (2008) links teachers' PCK to students' learning.

The years after Shulman's seminal work, most scholars argue that such knowledge contribute fully on the students' success. Based on this notion, pre service programs and professional development opportunities input greatly on developing PCK and CK of teachers. Recent research on this topic try to record the level of PCK and CK of teachers of different subjects/specialization. Descriptions abound on what particular knowledge in English, for example, comprise a teacher's CK and PCK. The development of content tests, described in this paper, adds to the description of particular knowledge that teachers have.

PCK in Philippine K to 12 curriculum

The Implementing Rules and Regulations of the Enhanced Basic Education Act of 2013 states that in order to fully and effectively implement the K to 12 curriculum reform, there is a need to conduct training of teachers in the areas of content and pedagogy. In fact, DepEd sponsors series of trainings on content and performance standards of the enhanced basic education curriculum for teachers. Presented below is an example of from the K to 12 curriculum document which shows the content and performance standards for English and the focus of the training programs for teachers.

Table 1 Sample of content and performance standards of the K to 12 curriculum for English

Reading Comprehension (RC)	Listening Comprehension (LC)	Viewing Comprehension (VC)	Vocabulary Development (VD)	Literature (LT)	Writing and Composition (WC)	Oral Language and Fluency (F)	Grammar Awareness (G)
EN7RC-III-a-8: Use one's schema to better understand a text	EN7LC-III-a-7: Use different listening strategies based on purpose, topic and levels of difficulty of simple informative and short narrative texts	EN7VC-III-a-13: Determine the key message conveyed in the material viewed	EN7V-III-a-13.11: Categorize words or expressions according to shades of meaning	EN7LT-III-a-5: Discover literature as a tool to assert one's unique identity and to better understand other people	EN7WC-III-a-2.2: Compose simple narrative texts	EN7OL-III-a-1.3: Express ideas, opinions, feelings and emotions during interviews, group/panel discussions, forums/fora, debates, etc.	EN7G-III-a-1: Link sentences using logical connectors that signal chronological and logical sequence and summation
EN7RC-III-a-8.1: Use one's schema as basis for conjectures made about a text	EN7LC-III-a-2.1/3.1: Note specific details of the text listened to		EN7V-III-a-13.11.1: Identify collocations used in a selection	EN7LT-III-a-5.1: Identify the distinguishing features of literature during the Period of Emergence	EN7WC-III-a-2.2.12: Identify features of narrative writing	EN7OL-III-a-5: Use the appropriate prosodic features of speech during interviews, discussions and forums	

The K to 12 reform aims to decongest primary and secondary education to allow for mastery, and is learner centered for optimum development of every learner. The content and performance standards feature of the curriculum places much importance on the development of important skills and competencies among learners. In order to address this strong demand for learning, teachers must be trained to deliver efficiently and effectively the new curriculum. Training programs for teachers must be properly designed to emphasize on the specific needs of teachers. This paper argues that before any planning of training programs is conducted, there must be a thorough evaluation of the teachers' knowledge of the contents of the new curriculum. The gap however, is that in the Philippines, there is no existing tool, which aims to assess the content knowledge of teachers other than the Licensure Examination for Teachers (LET), which is administered by the Professional Regulation Commission (PRC). This examination, however, does not test the preservice teachers' content knowledge on K to 12, the latter being very new in the Philippine educational system.

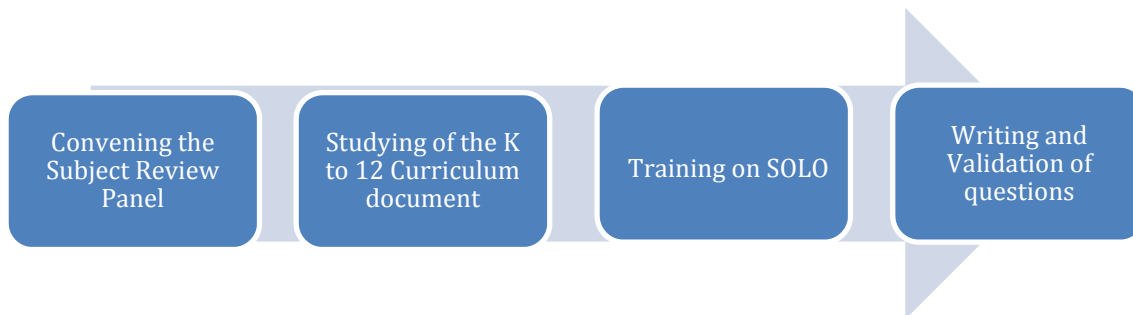
Test Development Discussion

This study used the descriptive-developmental research, which describes the process of developing content tools for assessing the content knowledge and pedagogical content knowledge of teachers in the Philippines in the light of the K to 12 educational reform. This article chronicles the effort undertaken by the

research team in the development of content tools in the hope that it can be used as a gauge in measuring the Filipino teachers' actual knowledge in the light of the new curriculum.

The main purpose of this study was to develop content tests to address the pedagogical content knowledge of teachers in the Philippines. The main intention of the development of the content tests is to determine teachers' actual knowledge of the new curriculum and also reflect information on the overall knowledge of teachers in the areas of focus (Mathematics, Science, English and Filipino) and the teaching profession in general.

The steps on the development of content tests is best summarized using the sequence of stages presented here:



Convening the Subject Review Panel

The process began with the convening of the Subject Review Panel, a group which led in the development of content test for the different subject areas. The members of the panels were chosen based on set criteria:

- a. They have relevant degrees in the field of Mathematics, Science, English and Filipino.
- b. They have been teaching the subject for the last 3 years.
- c. They are involved in any work on curriculum inside or outside the University.

The members of the Subject Review Panel were from the Philippine Normal University, which has the mandate of helping quality in the country being the country's National Center for Teacher Education, and from other Higher Education Institutions (HEIs) from the National Capital Region (NCR).

Studying the K to 12 curriculum document

After convening the panels, the members met to read and thoroughly study the available recent K to 12 curriculum on the following subject areas: Mathematics, Science, English and Filipino. The documents used were downloaded from the DepEd website (www.deped.gov.ph). Each document was read with focus and emphasis on the following points:

1. The curriculum ensures that there is an integrated and seamless learning or the spiral progression. In context, this means that the basic/general concepts are learned before the more complex and sophisticated version of those basic/general concepts. Such progression is geared towards strengthening the retention and enhancing the mastery of topics and skills for students to learn topics and skills appropriate to their developmental and cognitive skills (<http://www.deped.gov.ph/k-to-12/About/features>)
2. The curriculum is relevant to learners (contextualization and enhancements). All of the suggested activities, reading or listening materials, visual materials are all based on local culture, history and reality. This feature of the new curriculum allows for more in depth acquisition of knowledge, skills, values and attitude through continuity and consistency across levels and subjects. (<http://www.deped.gov.ph/k-to-12/About/features>)

The study of the documents led to the writing of the Table of Specifications (TOS) which focused largely on:

1. what can be measured in a pen and paper test. Some competencies, expectedly, are oral in nature, i.e. oral language competencies for English. Such are not included in the TOS and not reflected in the content tools.
2. competencies which reflect the alignments of the subject to the outcomes expected of learners who had training under the new curriculum; i.e. *Buo at ganap na Filipino na may kapaki pakinabang na literasi* from the Filipino curriculum (translation in English holistic Filipino steeped with functional literacy).

Training on SOLO

An important feature of content test developed is the use of the SOLO framework. SOLO stands for Structure of Observed Learning Outcome developed by Collis and Biggs (1982). The framework focuses on the level of responses of the test taker on a given circumstance. Mainly, the model requires a consideration of the “working memory” at a given situation of the test taker. Not taken as a ‘penalizing model’, it carefully describes levels of complex understanding. Put simply, SOLO conceives understanding as an increase in the number and complexity of connections students make as they progress in learning. SOLO focuses on the most sophisticated response that a student can provide to a task do at a particular time. (Biggs & Collis, 1989; Biggs & Collis, 1991).

The members of the review panel were trained on SOLO, as system to classify the quality of a response, in order to ascertain the level of responses the teachers would have in the questions in the content tests. SOLO accounts for four levels described as unistructural, multistructural, and relational. To address this, the developed content tests have multiple choice items and free response items.

Writing and Validating of Test Questions

In writing test items, primary concern is the representation of the competencies in the curriculum. The table below presents the different domains of competencies taken from the curriculum of the four target subject areas. These serve as the basis for the writing of the test questions written for each content test. Another important consideration is to test those competencies, which represent the grade level. The K to 12 reform articulates core learning standards, key stage standard, and grade level standards which reflect the spiral cumulative of the curriculum (www.deped.gov.ph). The goal is to be able to represent the more general competencies in the curriculum and those, which could be measured using pen and paper tests.

Table 2 Learning standards for the four subject area in focus

Discipline	Domain	Sub strands
English	<ul style="list-style-type: none"> • Book and Print Knowledge • Phonics and Word Recognition • Writing and Composition • Grammar Awareness and Structure • Vocabulary Development • Reading Comprehension • Study Strategies 	<ul style="list-style-type: none"> • Reading • Reading • Reading and Writing • Reading and Writing • Reading and Writing • Reading
Filipino	<ul style="list-style-type: none"> • Gramatika at Kayarian ng Wika (Grammar and Language Structure) • Pag unlad ng Talasalitaan (Vocabulary Development) • Pagsulat at Komposisyon (Writing and Composition) • Pag unawa sa Binasa (Reading Comprehension) • Estratehiya sa Pag aaral (Study Strategies) 	<ul style="list-style-type: none"> • Pagbasa at Pagsulat (Reading and Writing) • Pagbasa at Pagsulat (Reading and Writing) • Pagbasa at Pagsulat (Reading and Writing) • Pagbasa (Reading) • Pagbasa at Pagsulat (Reading and Writing)
Mathematics	<ul style="list-style-type: none"> • Number and Number Sense • Geometry • Patterns and Algebra • Measurement • Statistics and Probability 	
Science	<ul style="list-style-type: none"> • Biology • Chemistry • Physics • Earth Science 	

To sum up, the developed content tests aimed to assess these facets: knowledge of specific content, aptitude for teaching the subject, and knowledge of tasks relating to the subject matter. Literatures support these areas tested in each developed content tests. The separate categories reflect what Magnusson, Krajcik, & Borko (1999) and Gess-Newsome (1999) posited as transformative models of PCK.

Questions for knowledge of specific content (Content Knowledge) elicit test takers' knowledge on the demands of the curriculum on a specific subject area. Questions under this category can be directly mapped to the competencies present in the K to 12 curriculum. Put differently, inside the classroom, strong PCK paves the way for the acquisition of knowledge by students in ways that align with the intent of the curriculum reforms. The questions give us a glimpse of which in the content knowledge teachers know to teach.

Aptitude for teaching the subject area give reference to the over all ability of teachers to understand 'how to teach' the particular competency. Questions under this category relate the situation to the 'real classroom scenario'. Questions that relate to this category is supported by Shulman (1987) when he pointed to the PCK as the transformation of subject matter knowledge. So that it can be used effectively and flexibility in the interaction between teachers and learners in the classroom (Ball, et. al. 2001) .

Questions on knowledge of tasks relating to the subject matter allows the test takers to demonstrate their understanding of the different competencies of each subject area. Drawing on Grossman (1990) and Lortie (1975), the knowledge of tasks reflects the teachers' experiences coupled with their content knowledge. In this perspective, Grossman (2009) argues that teachers' knowledge is shaped by their own experiences.

Pilot Testing

The developed content tests were subjected to pilot testing to ensure that they respond well the curriculum and they offer good information and data to inform DepEd on the possible training programs to address teachers' needs. The series of pilot testing invited randomly selected schools in one region in the country.

The data were subjected to statistical analyses to determine the tools' psychometric characteristics. The members of the Subject Review Panel used the results of the analyses to review and revise the tools. Some items presented in the content tools were removed if they were found not having good psychometric characteristics, meaning, they wont provide much information to determine teachers' actual knowledge. Some questions were reworded in order to assist the teachers to respond correctly to the question. This strategy is consistent with the SOLO model's consideration of 'learners familiarity with the elements of operation, a pattern of response structure of increasing complexity becomes apparent according to the ease with which students process question cues (McPhan, 2008). Another round of iterative process was conducted to ensure that the tools is in the best form to give information on the PCK of teachers in the country.

Presented here are samples of test questions subjected to statistical analyses.

Table 3 Sample Test Question for English

Competency	Question	SOLO Code
Draw conclusions from a set of details; organize notes taken from expository text	54. Arrange the sentences in order to make a coherent paragraph: (1) Changes in food preparation methods, for example, have improved our lives greatly. (2) The twentieth century has brought with it many advances. (3) In some ways life is worse, but mostly it is better. (4) With those advances human lives have changed dramatically. A. 4, 3, 2, B. 3, 1, 2, 4 C. 2, 3, 4, 1 D. 2, 4, 3, 1	A. 0 B. 1 C. 2 D. 3

Table 4 Rasch analysis of the sample item

Item 54	Infit MNSQ = 1.24				
Disc = .27					
Categories	A	B	C	D	missing
Count	1	9	37	9	0
Percent (%)	1.8	16.1	66.1	16.1	
Pt-Biserial	-.18	-.18	.31	-.16	
p-value	.097	.096	.010	.125	
Mean Ability	.45	.88	1.20	.91	NA
Step Labels	1	2	3		
Thresholds	.27	.33	.66		
Error	.52	.51	.49		

The final form of the content tests includes multiple choice questions, free response questions and

51 item 51	.	.	*		.
52 item 52	.	.	*		.
53 item 53	.	.	*		.
54 item 54	.	.	.		*
55 item 55	.	.	.		*
56 item 56	.	.	.		*

teacher survey. Final check was done on the format for visual consistency.

The process on the development of content test discussed here is in consonance to steps in test development according to Downing (2006). The table below shows the correspondence of the processes.

Stages carried out in the development of content test to assess teachers' PCK	Effective Test Development (Downing, 2006)	Specific steps followed
Planning	Over all plan	The researchers brainstormed on the need to assess teachers' PCK in the Philippines. This is part of the planning of research themes for RCTQ as advised by DepEd.
Detailing of activities in the development of the content test	Content definition	The specific steps on the development of content test were discussed. This included convening of the Subject Review Panel.
Writing of the Table of Specifications	Test Specifications	The Subject Review Panel (SRP) studied the most recent and available K to 12 curriculum document to write the Table of Specifications (TOS). The TOS was subjected to a series of validation. This step also included the decision on the choices of which competencies and standards will be tested.
Writing of Test Questions	Item development	The members of the Subject Review Panel held workshops to write test items. They followed an iterative process of validation, editing, and rewriting of items to meet the SOLO framework that the test follows. Clarifications on items for multiple choice and for the free response were also discussed.
Writing, validation, finalizing of Rubrics for free response	Test design and assembly	The SRP followed another iterative process in writing, validation and finalizing of the rubrics for free response part of the content tests.
Finalizing content tests for visual consistency	Test production	The content tests were subjected to final rounds of editing to achieve visual consistency before they are sent to a chosen printing press for production.
Pilot testing	Test Administration	The content tests were subjected to a series of pilot testing to address validity, reliability and their consistency with the SOLO framework.
Coding/marketing of free response part of the test	Scoring test responses	The responses of teachers in the free response questions in all content tests were coded/graded using the prepared rubrics. The members of the SRP were trained on the process.
Rasch analysis of the content tests and the results of the pilot testing	Passing scores	All responses of teachers in the multiple choice and free response were analyzed using Rasch model/item response theory. The responses were compared to the over all ability of the teachers.
Reporting test results	Reporting test results	The results of the pilot testing were reported and discussed with the stakeholders.

Implications to Philippine Education

Teacher quality is one of the driving forces of Philippine education laws and reforms. Significant to the definition and subsequent realization of the teacher quality is knowledge of the current curriculum. The K to 12 mandates the whole education sector and stakeholders to focus attention and effort in bringing to the classroom the best learning experiences for both learners and teachers. The development of content tools provide for much needed evidence based policy advice on the possible training programs for teachers in the country by assessing the teachers' knowledge. The development of content tests to measure teachers Pedagogical Content Knowledge underscores a concrete basis for the desired intervention or solutions programs. Understanding the level of PCK knowledge of teachers will affect quality assurance on the deliver of the curriculum because the teacher remains to be the single most important success factor in the deliver of the curriculum (Darling-Hammond, 2006). Further, since policies to ensure that the teaching workforce has the needed and necessary competencies to determine what a classroom teacher needs reflects a more diverse assessment of the important factors of the learning curve. Considered as an iterative process, any changes in the educational process, including the question on ownership of any plans and, measuring PCK and CK knowledge greatly signifies that it is a key to improving education. In fact, Glenn (2000) reported that in order to understand the PCK of teachers and its long-term improvement, there is a need to figure out how to generate, accumulate, and share professional knowledge. The developed content tools serve as good start in the hope of accumulating information from Filipino teachers in the entire country with the primary aim of bringing about change in the country's education sector. The assessment of PCK of teachers also ensures a deep understanding of the need to strengthen teaching and learning in the classroom, thereby ensuring that the students acquire understanding that align with the intent of curricular reforms.

The process followed in the development of content tests also impressed among all stakeholders involved the need to reach a common ground to help address the needs of the education sector especially of the teachers. The significance and relevance of using content tests to assess teachers' PCK is also underscored in the process. The results of the assessment of teachers using the developed content tests served as basis for all other major research projects of RCTQ: Pre service Teacher Development Needs Study (PTDNS), Developmental National Competency Based Teacher Standards (D-NCBTS), and a partnership with World Bank in a research on public expenditure, which are all focused on improving teacher quality and development. Lastly, this research and report on the process involved reiterates the importance of addressing the needs of what is considered the most important part of education- the teachers.

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