Unpacking The Content To Find The Pedagogy

Kerry Holmes, (Email: kholmes@olemiss.edu), University of Mississippi
Barbara J. Dougherty, (Email: bdougher@olemiss.edu), University of Mississippi

ABSTRACT

This paper explores the issues surrounding the relationship among content, contentpedagogical, and pedagogical knowledge uses in the areas of mathematics and reading. In this era of teacher accountability, it is prudent to examine the types of knowledge teachers must possess to reach an increasingly diverse student population.

INTRODUCTION

The focus on teacher qualifications, or “highly qualified teachers” with regard to the *No Child Left Behind Act*, is as old as the beginning of universal schooling advocated by Horace Mann (1796–1859). As in other professions, the quality of professionals is judged not only by the body of specialized knowledge they possess, but by the quality of their services whether the end result of a professional service is an appendectomy, a hair cut, or the design of the computer that runs a car. A professional’s knowledge and the expertise to implement this knowledge are critical. The profession of education is no exception.

Beginning with the Coleman Report, 1966, studies have shown that a strong link exists between teachers’ prior knowledge of the content they teach and student learning or achievement (Moats & Foorman, 2003; Chaney, 1995; Ferguson and Womack, 1993; Fetler, 1999; Monk, 1994; National Commission on Teaching and America’s Future, 1996). However, Darling-Hammond (2000) reports that studies on the connection between content knowledge and student achievement have been mixed. She found that content knowledge alone has not been shown to account for increased student achievement; pedagogy plays a significant role as well. The relationship between content knowledge and student learning is approximated by a curvilinear relationship as depicted in figure 1.

Figure 1

Figure 1 shows an initial positive linear relationship between teacher content knowledge and student learning. Though the point of saturation is not quantified, it is reasonable to expect that when teachers' knowledge far exceeds the curriculum, its effect on student learning levels off.

Results from studies on content specific methods courses, courses that combine content and pedagogy, have shown a statistically significant impact on student learning (Darling-Hammond, 2000). Darling-Hammond states, "It may be that the positive effects of subject matter knowledge are augmented or offset by knowledge of how to teach the subject of various kinds of students. That is, the degree of pedagogical skill may interact with subject matter knowledge to bolster or reduce teacher performance" (2000, p. 4).

Three types of teacher knowledge contribute to an effective classroom practices. These include knowledge of content, pedagogy, and pedagogical content knowledge to determine how aspects of content and pedagogy work together to impact student learning. This paper unpacks or deconstructs the content, pedagogical, and pedagogical content knowledge that teachers of reading and mathematics in grades K-6 must know in order to have a positive effect on student learning.

Content knowledge refers to the subject matter the teacher is called upon to cover in lessons. Pedagogical knowledge relates to the techniques, procedures, attitudes, and elements of cognitive and developmental psychology that impact student learning. Shulman (1986) merged what had been these two discrete areas of professional knowledge, by creating a third category of professional knowledge, pedagogical content knowledge. By merging content with pedagogy, Shulman takes knowledge and pedagogy to a higher level where the teacher skillfully determines *what* to teach (content knowledge) and *how* to teach (pedagogy). The level of teacher understanding about what and how to teach forms a professional knowledge base that has a direct and significant impact on student learning.

Each teacher brings an array of knowledge to the classroom resulting from his/her years of education, family and cultural environments, and unique personal experiences. Not all knowledge contributes equally to the teacher's performance in the classroom, and not all knowledge is equal as far as student learning is concerned. Teachers are constantly called upon to make professional decisions that have a direct impact on their students. These decisions are dependent upon their specialized knowledge of content knowledge and pedagogy. Students are not automatons, sitting patiently waiting for instruction and direction from the teacher; rather they come to class with their own sets of needs, wants, and expectations. Before planning any lesson, teachers must make decisions about the changes they want to effect in each student as a result of their lesson, and how best to facilitate these changes. Madeline Hunter (1993, p. 3) states, "...teaching is now defined as a constant stream of professional decisions made before, during and after interaction with the student: decisions which, when implemented, increase the probability of learning." Thus teaching decisions focus on what the students will learn to do and how the students will demonstrate the learning.

To ensure that teachers make appropriate instructional decisions, this paper explores the critical issue of professional competency, specifically competency in content knowledge, pedagogy, and Shulman's pedagogical content knowledge related to reading and mathematics. We contend that content knowledge drives pedagogy. Without a thorough grounding in the content they teach, teachers cannot choose or adequately implement appropriate pedagogy to help students learn.

CONTENT KNOWLEDGE

A teacher's knowledge of content and knowledge of pedagogy are independent of each other, derived from different sources. Individuals can possess one type of knowledge without knowing anything about the other. For instance, it is legend that many experts in scientific fields have no interest in or ability to teach their knowledge to others. Conversely, it is also a common complaint in the late twentieth century that teachers are being taught "how to teach" without adequate grounding in subject area content.

Once teachers possess content, pedagogy, and pedagogical content knowledge, they have the necessary tools, skills, and knowledge to move students beyond acquiring facts, skills, and processes for fuzzy nondescript purposes,

to purposeful, meaningful learning. Skilled teachers can create an environment where students learn and integrate knowledge as they make decisions, solve problems, make inferences, and transfer learning to other situations. This process is shown in figure 2.

Figure 2

An effective teacher must not only have the content knowledge necessary to meet the learning levels of his/her students, but also know how to differentiate teaching techniques to engage students.

Because reading and mathematics are critical to school success, personal success, and ultimately our nation's well being and security, major reform efforts are being enacted to increase student performance in reading and mathematics. To determine how to reform the teaching and learning in these content areas, we have deconstructed the content knowledge for reading and mathematics that teachers must know.

UNPACKING THE CONTENT: WHAT TEACHERS MUST KNOW TO TEACH READING

We have removed reading from the larger package of language arts and packaged it by itself. In this section we focus on unpacking the smaller pieces of underlying knowledge necessary for the teaching of reading.

To teach reading, teachers must learn and master a specialized body of knowledge about the skills, processes, and goals inherent to reading. To determine the content knowledge teachers must possess to be effective reading teachers, we must first define reading and identify its goals. Reading is the integration of some or all of its subskills, (decoding, word recognition, and fluency) that lead to comprehension, the ultimate goal. The National Assessment of Educational Progress (NAEP, 2005) lists three different goals for reading: (1) reading for literary experience, (2) reading for information, and (3) reading to perform a task.

Issues concerning what and how to teach reading have been the heated subject of debate for the past 25 years. The types of content knowledge needed to teach reading became muddled during the 1980s when two opposing views, holistic and traditional, clashed on how children learn to read. If one subscribes to the holistic whole language viewpoint, then learning to read is a natural act akin to learning to speak (Goodman, 1986; Smith, 1983). Teachers facilitate reading through a print-rich classroom by providing time, encouragement, plenty of good books, and a

variety of written texts for the students. Terms such as immersion, marinating, and exposing children to text led to a learn-to-read-by-reading curriculum that shifted the focus of reading instruction away from teachers' knowledge of content to teachers' knowledge of pedagogy. But if teachers regard reading as an unnatural act they will focus their instruction on traditional skills instruction; they must be prepared to lead students through a planned, systematic, and explicitly delivered instruction of phonemic and phonological awareness, phonics, reading comprehension, and syntax. Thus content knowledge is of primary concern.

It is important to note that teachers on both sides of the reading debate must know the linguistic content for phonemic and phonological awareness, and phonics, as well as strategies for teaching fluency, reading comprehension, and syntax, the structure of language. Whether skills are taught through teachable moments as they arise in a whole language classroom, or systematically in a traditional classroom, all classroom teachers must have a solid base of content knowledge for teaching the skills necessary for reading achievement.

Teachers must have more than a superficial mastery of isolated basic facts and processes so they can sequence the content for learning, plan a variety of ways to teach reading skills, as well as use their knowledge of content to diagnose students' reading strengths and weakness. For example, if a child used the following spelling for "flower", a teacher knowledgeable in phonemic awareness and phonics would celebrate the child's success of using the correct sound symbol orthography to write the word. The child only needs to learn about "er," an r-controlled vowel, to complete the learning for the spelling of the word flower. An unskilled teacher could not help the child take this extra learning step and would likely teach the spelling for flower by repetition.

We have unpacked and examined the categories of content skills separately from a number of sources including the National Reading Panel (NRP), the National Council for the Teachers of English (NCTE) Standards for the English Language Arts, and the International Reading Association (IRA). Content knowledge for reading falls roughly into the following five categories: 1) alphabets, 2) fluency, 3) vocabulary development, 4) comprehension, and 5) syntax. Ways teachers use pedagogy to translate their knowledge of reading content into reading achievement are described in the section on reading pedagogy.

Alphabetic

Teachers must have solid knowledge of the sounds and symbols of language including phonemes, phonology, morphemes, graphemes, and phonics. In addition, they must know how children acquire an awareness of phonemes, and which phonemic awareness tasks are most difficult for the student. Teachers have to possess specific skills in phonemic awareness, graphemes and orthography, phonological awareness, and phonics.

- **Phonemic Awareness:** Phonemes, the smallest meaningful units of sound used in spoken language, are the building blocks of syllables and words. For children to become successful readers, they must know and manipulate the sounds comprising their language (NRP, 2001).
- **Phonological Awareness:** The sounds of language including phonemes, morphemes, syllables, and whole words comprise phonological awareness. Children progress through a developmental sequence that proceeds from a large body of sound to a single unit of meaningful sound.
- **Graphemes and Orthography:** Graphemes are the written symbols that correspond to spoken phonemes. Orthography, using the written word to convey thoughts and ideas, requires students to learn individual graphemes to form words.
- **Phonics:** Phonics is a combination of phonological awareness and orthography, often expressed as sound/symbol correspondence. Teachers must know the steps readers use to decode new words, including transforming graphemes into phonemes and blending phonemes to form recognizable words.

Fluency

Teachers must know how fluency develops, its place in the hierarchy of reading skills, and what it means to be a fluent reader. Fluency is important for the reader to maintain interest in the reading and from the cognitive standpoint of information processing as students' short-term or working memories can hold limited information.

Vocabulary Development

Knowledge of vocabulary is critical to reading comprehension (Blachowicz, & Fisher, 2004; Lundberg, 2002; Stanaovich, 1986). Students come to school with four different levels of vocabulary knowledge: receptive, oral, reading, and writing. The receptive vocabulary, the largest of the three, is the sum of all words a student has ever heard and retained in memory. Students possess words in their receptive vocabularies that they do not know well enough to use in speaking, reading, or writing. When teachers are aware of the way students learn, store, and use words, they can plan experiences to help them extend and use their vocabularies.

Comprehension

Because comprehension is the very heart of reading, it should be the foremost element of the reading curriculum (Barton & Sawyer, 2003). Researchers (Harris & Hodges, 1995) define comprehension as “intentional thinking” where readers construct meaning based on their own experiences and the text they are reading.

In our experience, all too often pre-service teachers assigned to the lower grades K–3 feel that because they can read, they know enough to teach reading. The following example sadly illustrates the effect of planning lessons with little or no regard of the academic content.

When a first-grade student teacher was asked why she only planned to teach the long sounds for the vowels, she said she was uncertain how to teach the other sounds for vowels, especially those with three sounds (long, short, and dotted). The r-controlled vowels created more consternation; the vowel sounds were not fitting with this student teacher’s previously learned knowledge. By teaching only the knowledge in her head, the student teacher could not move into the complexities of the lesson that were sure to arise. Those pesky vowels were not cooperating by being either long or short. She was poised to teach a rather simple lesson on vowels, most likely sweeping questions about the other vowel sounds away with a vague response while moving on to more comfortable ground. Unless she learns more reading content knowledge, this pre-service teacher will continue to teach students what she knows rather than the complex knowledge base of skills students must learn to become fluent readers. This lesson was devoid of the deep content knowledge necessary for sound and informed pedagogical decisions. What the students learn is largely dependent upon the knowledge of their teacher.

When faced with linguistic ignorance, some teachers simply ignore the alphabetical structure of language and use a potpourri of unplanned, unsustained reading strategies. Words that students can be taught to decode are simply taught as sight words, if taught at all. These teachers unknowingly consigned their students to learning hundreds, or thousands of sight words rather than the 44 phonemes (digraphs, diphthongs, r-controlled vowels included) that comprise the English alphabetic system.

UNPACKING THE CONTENT: WHAT TEACHERS MUST KNOW TO TEACH MATHEMATICS

Similar to research on reading, teacher mathematical content preparation positively influences student achievement. (Chaney, 1995; Darling-Hammond, 2000; Ferguson and Womack, 1993; Fetler, 1999; Monk, 1994; National Commission on Teaching and America’s Future, 1996). Many universities are attempting to add more courses in mathematics for the elementary education majors as a way to increase the mathematics that these teachers would have access to.

In theory, these courses would cover an array of mathematics as recommended by the Mathematical Association of America (MAA) in their 1991 document. The course content would include number systems and number sense, geometry, measurement, statistics and probability, and functions and their uses.

Additionally, NCATE in conjunction with Association for Childhood Education International (ACEI) (1999) also issued recommendations for programs in which pre-service teachers would learn mathematics such that “candidates know, understand, and use the major concepts, procedures, and reasoning processes of mathematics that define number systems and number sense, geometry, measurement, statistics and probability, and algebra in order to

foster student understanding and use of patterns, quantities, and spatial relationships that can represent phenomena, solve problems, and manage data (p. 8).” In supporting statements following this recommendation, there is reference to teachers ‘helping’ students understand mathematics but it lacks specificity for the teacher. In neither case of ACEI/NCATE and MAA is there a definitive document or set of recommendations that pinpoint the actual mathematics that teachers should know in order to teach effectively.

Thus creating the courses to accommodate the span of content needed for effective teaching of mathematics becomes problematic. The depth and breadth of the mathematics is so large that it is not feasible to ‘cover’ all topics. It is, therefore, likely that mathematics courses for elementary teachers will omit important topics or will treat them with such superficiality that teachers are no better prepared than if they had not taken the courses. Specific content is important and decisions about what subject matter and in what depth are critical.

It may be that traditional university courses in mathematics are not the most appropriate courses for prospective elementary teachers. Rather, careful planning should be undertaken to provide courses that allow pre-service teachers opportunities to grapple with and understand content that may be assumed to be easy, since it deals with K–4 education, but that is truly important content for teachers (MSEB report to NSF, March 1996). As Mosenthal and Ball (1992) suggest, teachers, regardless of what they learn or are exposed to in higher-education courses, they may rely on what is most pertinent in their classroom, the content that they themselves experienced in their own elementary career. This sets the stage for teachers to easily resort to the same content teaching methods from which they learned mathematics when they are faced with situations in which they are unsure of the content itself or the way in which to effectively teach it.

The amount of mathematics content needed to produce effective and competent teachers is under contention. It can be argued that increasing content-based courses does not necessarily mean that teachers will apply the knowledge acquired in these courses to their own teaching. This is partly due to the low correlation between the mathematics they are taught in higher-education courses and the mathematics they are asked to teach in the elementary grades.

Unlike reading, mathematics is not well-defined in specific content knowledge that teachers need. Combined with the requirement for taking college-level courses that are designed for liberal arts content, prospective teachers often learn little about the actual content appropriate for elementary school children and are left to discover on their own how to interpret even tenuous links.

COMBINING CONTENT-KNOWLEDGE WITH PEDAGOGICAL KNOWLEDGE: WHAT THE TEACHER MUST DO TO TEACH READING AND MATHEMATICS

Shulman, 1986, advocates that teachers must use pedagogy to transform content knowledge into learning experiences for a diverse student population (figure 2). This transformation requires a strong knowledge of the content and pedagogy. Instructional strategies, whether they are inductive, deductive, or a combination, must be tied to specific goals that are crystal clear to the teacher and the students. Instruction cannot produce strong and robust student achievement if the purpose for the lesson is not well defined. Even though defining an outcome for a lesson sounds relatively easy, that very definition is dependent upon a teacher’s view of the discipline itself. If mathematics, for example, is viewed as a subject area in which skills, fact, and algorithms define the content, then the lesson is designed with the intent of helping students become proficient in applying a particular method to exercises that require little thought.

Many believe that phonics, for example, and mathematics are best taught through a series of redundant and often boring worksheets. There is little to engage the mind when all that is important is the one correct answer. Unfortunately, students come to expect such worksheets and are often taken aback when a more student-centered approach to teaching is used.

Creating lessons that engage and motivate students in the content is critical in promoting strong student learning. Including literature and providing hands-on tasks in both reading and mathematics instruction are ways to

motivate and engage students. The danger here rests not in the activity itself but in the way in which the activity is structured. Teachers who do not understand the content or have a limited view of subject matter content may use the activity just for the sake of having something 'fun' in the class. The heart of the content being presented rests, in many activities, not in the physical doing of the activity but in the reflection and debriefing portions of the lesson where students are placed in situations that require higher-order thinking, use of communication strategies, and support, justification or proof of their ideas.

In mathematics and reading, the processes needed for high student achievement are both co-dependent and inseparable. Language is important; the development of the receptive and expressive vocabularies is essential for both content areas. While reading and writing vocabularies can be developed through trade books and other interesting literature, mathematical vocabulary is often taught by the teacher defining a word and then giving an example of it rather than by an approach that allows students the opportunities to create a working definition before a more definition is applied. This speaks again to the teachers' view of the rigidity of the discipline when their own content knowledge is not well developed.

Teachers' lesson formats often have a similar rigidity in that each lesson is structured in a cookie-cutter fashion. When one is uncomfortable with the content, the structure of the lesson is kept more consistent to avoid any surprises or unpredictability that may occur when other types of lesson formats are used. Higher-order questions are avoided in favor of factual questions that have one right answer; thus making students' responses easier to evaluate in terms of accuracy. This instruction does little to promote student interest but it does provide a structure that is comfortable for teachers and students alike.

Having a comfort zone does not indicate that students are learning. In order to promote stronger achievement in reading and mathematics, teachers need a large repertoire of instructional strategies to engage students and change passive thinking into active learning. Simply including activities will not bring about a positive impact on achievement. Lessons have to be created that meld the instructional strategies with the content in a way that is meaningful.

This melding is the marriage between pedagogy and content, or pedagogical content knowledge that helps the teacher bring the content to the students through effective instructional techniques. Pedagogical content knowledge in reading and mathematics is much more than merely crafting a lesson. It requires a much deeper understanding of a learning and teaching trajectory than just simply teaching a lesson.

When teachers effectively use their pedagogical content knowledge, they carefully choose materials that should be used in lessons to promote a deep understanding in students. The materials embed the content in such a way that students do not have to guess how the manipulatives or other materials model what they are learning.

To select the materials and the way in which the materials are used in the classroom, teachers have to know more than the content and the pedagogy. They have to understand how children learn reading and mathematics. The learning in these two areas is not based upon practice or rote memorization but through the immersion within the discipline itself, literally having students become mathematicians and authors.

Pedagogical content strategies include acclimating students to an environment in which they develop self-reflection skills. Students who readily ask 'what if. . .' or 'why is it that. . .' are those that are thinking deeply about the content rather than passively writing down or reading what the teacher asks. An environment that motivates students to be questioners has to be one in which students feel supported and encouraged, one in which there is no fear of humiliation or ridicule. Thus within pedagogical content strategies there must be techniques that build and maintain this environment.

Most importantly, teachers have to be able to analyze student errors and to evaluate and understand student explanations. The ability to know what to do when students have misconceptions is closely linked to understanding the content and having instructional techniques that can be used at this point. For example, in mathematics, if a student says that perimeter of a rectangle always increases when the area increases, a teacher must first know that this

is a misconception. Once the teacher recognizes that this is a misconception, he/she can ask if other students agree or disagree with some supporting evidence or proof. Or, the teacher could present some cases in which students are asked to find the area and perimeter and adjust the conjecture about their relationship based on their findings. Most often, if students suggest such a generalization, teachers may not recognize that this is in fact a misconception and if they do recognize that it is, they are not quite sure how to proceed. Misconceptions commonly arise in reading comprehension as well. For example when a student confuses “tear” and “tear” the teacher must know how to guide the student to use semantic and syntactical clues to determine meaning.

SUMMARY

This paper has attempted to show the links among content, pedagogy, and content pedagogy as necessary components of a teacher education program. The ties across these three areas suggest and support the need for all faculty involved in the teacher preparation program to teach in the way it is hoped these prospective teachers will teach when they complete their program. It also implies that a teacher education program has to include content courses that model not only good instructional techniques but that illustrate through the instructor’s modeling the effective use of pedagogical content knowledge.

Without coordination among faculty members, courses, programs, and colleges within the university, prospective teachers may not exit from their education program with the necessary knowledge and skills that are required in today’s classroom. There is a need for extensive research on how best to prepare teachers. These three knowledge areas (content, pedagogy, and content pedagogy) would be an appropriate framework to use for such research.

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