

Pedagogical Content Knowledge (PCK) As Pathway To Improved Teaching And Learning: Implications For Teacher Education

Kehinde O. Edewor & Biodun Ogunyemi

Abstract

The success or failure of any education system largely depends on the availability of quality teachers. It is professionally qualified teachers who translate the educational goals into classroom objectives and deploy relevant learning experiences for achieving the set objectives. Pedagogical content knowledge (PCK) demands of teachers a blend of knowledge of “what to teach” (content knowledge) with the knowledge of “how to teach” (pedagogical knowledge) the particular subject matter. It is when a balance of the two domains of practice is effectively achieved that school teaching and learning can be enhanced for improved outcomes. This exploratory work attempts a review of the concept and models of PCK as a pathway to enhancing the classroom practices of teachers for improved learning outcomes of learners. The work also brings out the implications of PCK for teacher educators as pipelines of ideas for professional teacher development. It notes that the controversies around “content experts” producing better learning outcomes than “expert teachers” or vice-versa removes from the demands of PCK and concludes that content knowledge and pedagogical knowledge are two sides of the same coin which are inseparable for a result-oriented professional practice and effective teacher education.

Keywords: Pedagogical Content Knowledge, School Teaching and Learning, Teacher Professional Development, Teacher Educators

Kehinde O. Edewor
edewor.kenny@ouuagoiwoye.edu.ng

Biodun Ogunyemi
ogunyemi.abiodun@ouuagoiwoye.edu.ng
Department of Arts and Social Sciences Education,
Olabisi Onabanjo University,
Ago-Iwoye

Introduction

Teachers are the pivots around which education revolves. Their availability and quality rub off on the school plant, the curriculum, the classroom and the entire ecosystem for teaching and learning. Teachers translate educational goals into instructional objectives which guide lesson preparation and delivery; including selection of learning experiences, instructional techniques and modes of determining the attainment of the set objectives. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) submits that teachers have the most direct roles in education because it is through them that national policies are translated into practical actions in schools (UNICEF/UNESCO, 2007). More than elsewhere, it is at the school level that the substance of education is broken down into activities through subject curricula the teachers are made to implement (IBE-UNESCO 2017).

Recent research has consistently reported poor performances in school subjects at internal and external examinations by primary and secondary learners, causes of which are linked with low pedagogical content knowledge of teachers (Olufsen et al., 2021; Suglo et al., 2023; Taylor, et al. 2016; Umudi, 2018; WAEC, 2020). Pedagogical content knowledge (PCK) provides a framework for analysing, understanding and predicting the competence level of classroom teachers as professional educators whose task is to optimize learning. The popularization of PCK is traceable to the work of Shulman (1986, 1987) who postulates that “To teach is first to understand”, suggesting that a teacher must know what he or she sets out to teach before the job can be done professionally. As Shulman insists, “knowledge of what to teach” is not enough; the skills or “know-how” of teaching must equally be present for student achievement to be optimized. Shulman's PCK is anchored on the intersection of activities associated with the “knowing what” and “knowing how” for clear understanding of the requirements of professional teaching.

Various researchers have reviewed and extended the work of Shulman emerging with various models of PCK since it became popular as from the mid-1980s. However, its implications for enhancing classroom practices for improved learning achieving in resource poor environment like Nigeria may not have been given adequate research attention in the pedagogy literature. This analytic contribution was therefore conceived with the aim of addressing the following main questions:

1. How can PCK be defined and what models are associated with it?
2. How does the PCK pathway benefit teaching and learning?
3. What are the implications PCK application for teacher educators?

The Concept and Models of PCK

Until the recent years, not much consideration was given to the teaching competence of those who taught children and young adults at schools. The general assumption was that anyone could teach, provided they knew what they set out to teach. This assumption fueled the preponderance of uncertificated teachers particularly in Nigerian schools and schools in other underdeveloped countries. This scenario could be likened to the presence of quack doctors or auxiliary nurses in the medical profession. The difference however was that, unlike in the medical field, auxiliary teachers were not restricted because there were no defined professional knowledge benchmarks for teaching. Over time, researchers began to question the adequacy or otherwise of the “knowledge-of-the-subject-matter” approach without being grounded in the theory and practice of teaching (pedagogy). Shulman (1986) calls this gap in research on teaching and teacher knowledge the “missing paradigm” which informs his idea of “pedagogical content knowledge” (PCK). According to Ball et al (2008), “What provoked broad interest was the suggestion that there is content knowledge unique to teaching—a kind of subject-matter-specific professional knowledge” (p. 389).

To Schulman, a professionally competent teacher should be able to explain “The most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, the ways of representation and formulating the subject that make it comprehensible to others” (Shulman, 1986, p. 9). While Grossman et al. (1989) explain PCK as the bridge which a teacher builds to link his or her understanding of the content to that of the students' understanding of the same content, Mafa-Theledi (2024) explains it in terms of capacity to connect the pedagogical knowledge (how to teach) with the content knowledge (what to teach).

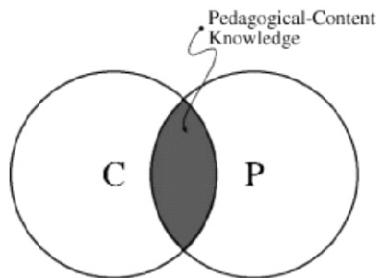


Figure1: The Two Circles of Pedagogical Knowledge and Content Knowledge joined by Pedagogical Content Knowledge.

Source: Mafa-Theledi (2024)

Research into PCK as a broad field of general education and narrowly as applied model for individual subject teaching has grown exponentially producing several models and variants. Shulman's (1987) seven categories of teacher's knowledge include general pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organisation that appear to transcend subject matter; knowledge of learners and their characteristics; knowledge of educational contexts, ranging from workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and knowledge of educational ends, purposes, and values, and their philosophical and historical grounds. Others are content knowledge; curriculum knowledge, with particular grasp of the materials and programmes that serve as "tools of the trade" for teachers; and pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding (Shulman, 1987, p. 8). To this perspective of PCK, others have contributed useful insights that help to illuminate the various tasks of teacher professional practice and implicit dimensions of teacher education. Grossman (1990) provides a synthesis of the delineation of teacher knowledge bases and their interrelationship with four major elements: general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge, and knowledge of context. Among these knowledge bases, however, PCK is seen as central to other knowledge bases for teachers' professional practice.

From the constructivist point of view, Cochran et al (1991) declare:

Pedagogical content knowledge is an integrated understanding that is synthesized from teacher knowledge of pedagogy, subject matter content, student characteristics, and the environmental context of Pedagogical Content Knowledge and learning. In other words, PCK is using the understandings of subject matter concepts, learning processes, and strategies for teaching the specific content of a discipline in a way that enables students to construct their own knowledge effectively in any given context (p. 1).

Some major dimensions of PCK in practice are as illustrated in Figure 2.

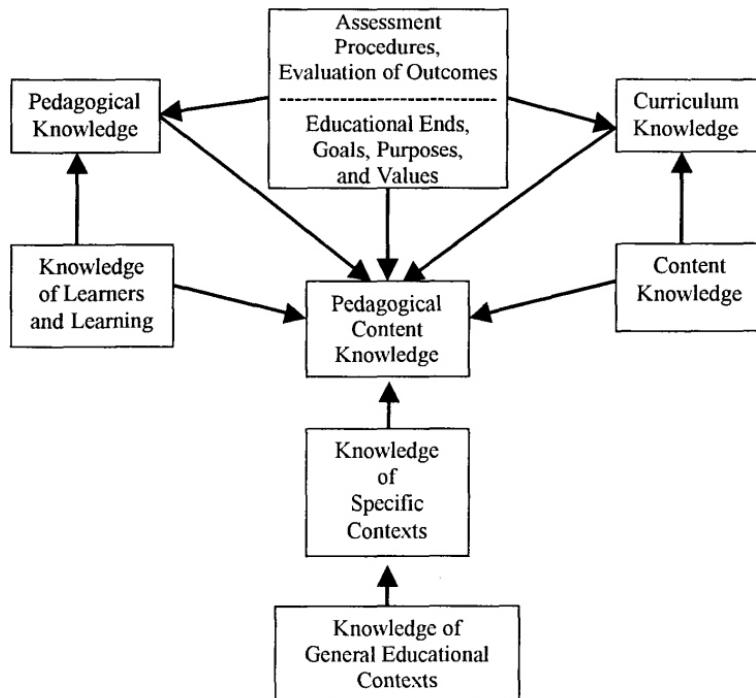


Figure 2: Categories Contributing to Pedagogical Content Knowledge

Source: Morine-Dersimer & Kent (1999).

Many scholars agree that high PCK levels are predictive of high student success levels (Adu et al., 2014; Jacob et al., 2020; Ling & Mahmud 2023). Nevertheless, research has not conclusively established the pathway for achieving this; resulting in a wide variety of models of PCK and its measuring techniques. Figures 3 sums up four alternative models or categories of teacher knowledge with reference to their individual domains.

Knowledge Category or Domain	Shulman, 1986b	Shulman & Sykes, 1986	Shulman, 1987	Grossman, 1990
Curriculum				
Learners and learning				
Liberal knowledge & skills (general)				
Pedagogy (general)				
Pedagogical content knowledge				
Performance skills				
Philosophy, goals, and objectives				
School contexts				
Subject matter (content)				
Substantive structures of the discipline				
Syntactic structures of the discipline				

Key	
Major category in the model	████████
Subsidiary category in the model	██████
Not explicitly referenced in the model	████

Figure 3: Domains of Teacher Knowledge: Four Alternatives

Source: Carlsen (1999)

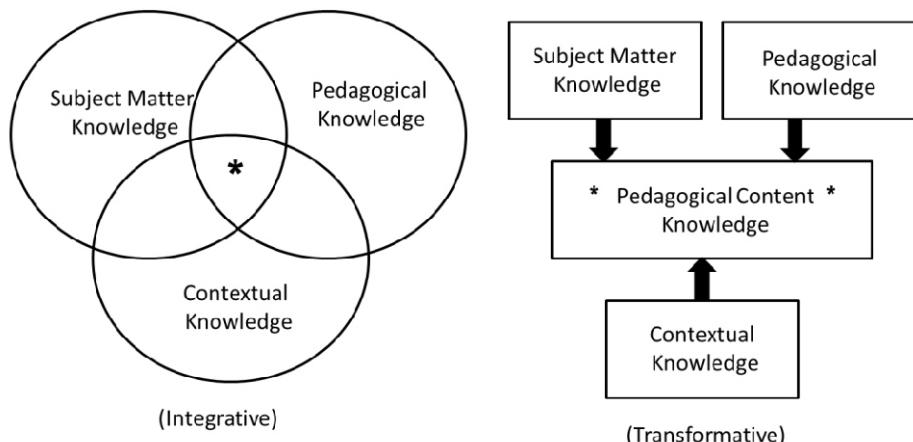


Figure 4: Integrative and Transformative Models of PCK

Source: Gess-Newsome (1999)

Arising from a critical review of the literature, Gess-Newsome (1999) came up two theoretical models to explain trends in the development of PCK: the Integrative Model and Transformative Model as presented in Figure 4. According to Fernandez (2014), the Integrative Model takes PCK as the intersection between the educational, disciplinary and contextual knowledge while the Transformative Model presents PCK as a product of a transformation of pedagogical knowledge, subject matter knowledge and context knowledge. However, the two (2) models agree that identifying particular student misconceptions and learning challenges, as well as representations of the subject matter and instructional strategies, are critical components of PCK. The emergence of the Refined Consensus Model (RCM) of PCK appears to further illustrate this seeming agreement. The model presents three major realms of a teacher's PCK: Collective PCK (cPCK), Personal PCK (pPCK), and Enacted PCK (ePCK). The cPCK describes the professional knowledge held in the field generally by educators and educationists, the pPCK refers to more personalized knowledge which resides in the individual teacher, while the ePCK explains "the knowledge subset upon which the teacher draws to guide pedagogical reasoning in planning, teaching, and reflecting on lessons taught" (van der Jagt & Nielsen, p. 543).

Benefits of the PCK Pathway to Teaching and Learning

Effective teaching demands that the teacher possess certain skills to be regarded as a professional. Such skills include ability to plan, communicate effectively and manage behaviour. PCK helps to identify gaps and weaknesses to be addressed. As a novel approach to teaching, PCK helps to initiate designs for personalising learning and making teaching and learning rich. PCK could make the teaching profession to continually undergo considerable transformation especially with the fresh opportunities created by technological advancement. PCK could raise standards of education locally and nationally as it places teaching in its wider professional context. PCK stresses professional values and practices. It emphasizes core professional competencies (knowledge, skills, and understanding) and looks at how learning takes place and how different aspects of teaching enhance learning.

Pedagogical Content Knowledge helps non-experts to be focused because each subject matter has its own terminology specific to it and to which non-experts might find difficult to comprehend. PCK ensures that the quality of

training of teachers is best by helping them to succeed. PCK is a call to unlearn some personal ideas and pick new ones that could help in teaching and learning. PCK emphasizes the need to experiment with a wider range of teaching and learning styles in a way that many other professions might not call for because teaching involves giving of oneself.

Teachers who are committed, knowledgeable, skilled, and well-trained are essential to any educational system's success (Blomeke et al., 2016; Nortvedt & Gustafson 2016; Scherer & Nilsen 2016). The level of knowledge a teacher has in a subject is a sign of their competence. However, the teacher's knowledge of teaching should go further than the specific content to include knowledge of how to teach, present subject-specific concepts (language, history, geography etc) and that of selection of materials. This implies that teachers' effectiveness in the classroom would be hampered if they are not versed in both the content knowledge and pedagogical knowledge (Adu, 2014). In contrast to teachers with weaker features or backgrounds, those with strong understandings of the concepts they are teaching as well as the ability to teach them are more likely to convey the content using clear language, be cohesive, and provide clearer explanations. Hence, the influence of the teacher factor cannot be underestimated in achieving productive learning in schools (Atieno, 2022; Jacob et al., 2020; Mafa-Theledi, 2024).

Implications for Teacher Education

The need for teacher education that supports quality teachers in Nigerian and African schools has long been acknowledged. According to UNESCO (2006, p.49), "While the sufficient number of teachers provides the opportunity to reach international goals on education, it is the effectiveness of teachers in the classroom which will deliver the Education for All promise." Besides, the aphorism "Quality teachers, quality education" applies not only to teachers in Africa but all across the world (Blomeke et al., 2016). Hence, UNESCO places a high premium on initial teacher preparation and teacher continuous professional development for quality education that produces good learning outcomes (UNESCO, 2021). Such training demands fostering the requisite knowledge, skills, values and other forms of competences provided through PCK. This is especially imperative in many parts of Nigeria where gross shortages of qualified

teachers are being augmented with untrained (as well as trained but uncertificated) teachers with doubtful levels of competences.

With PCK at the core of pre-service and in-service teacher education programmes, it is possible to open spaces for breaking down the contents of school subjects and matching them with relevant didactic and pedagogical procedures. By so doing, student teachers are assisted to develop their PCK as well as “acquire the critical capacity and analytical skills that allow them to design the classroom as a space exploration and continuing research.” (Fernandez, 2014, p.93). PCK is the transformation of instruction, a process through which a teacher critically evaluates and understands the subject matter and comes up with various ways to convey it through examples, problems, demonstrations, and classroom activities. The content is then tailored to the specific learners to whom it will be taught, taking into account their aptitudes, gender, past learning, and preconceptions—those informal or non-traditional pre-instructional views they bring to the classroom.

There is a continuous discussion about the effectiveness of teacher education around the world. A school of thought argues that content of subjects or disciplines should receive more emphasis in teacher education programmes than pedagogical course work. For example, according to the National Commission on Excellence in Education of the United States, many, if not most, of the country's schools, colleges, and education departments are only mediocrely preparing teachers for the demands of teaching in the twenty-first century (U.S. Department of Education, 2009). Many people think that having a solid foundation in the subject and a lot of enthusiasm are enough to start a successful teaching career. The former U.S. Secretary of Education, Rod Paige, suggested that education colleges be made optional and that required education coursework be removed in 2002, citing “little evidence that education school coursework leads to improved student achievement” (US Department of Education, 2009). This stance may have had an impact on the majority of states' Department of Education decisions to pass new legislation and rearrange the requirements for teacher preparation so that more subject courses and less education courses were required (Virginia Department of Education, 2007). However, the “less-education” approach to the training of teachers has not gone unchallenged by teacher education scholars who subscribe to the perspective of PCK as represented by Shulman and others.

The teacher is a significant factor in the teaching and learning equation. Effective preparation of teachers should make them understand the foundational basis of the subject matter, the topics, and concepts and make ready to assist students to understand and find ways to explain how one idea relates to the other (Shulman, 1986). The pre-service and in-service teachers must also be prepared to handle time allocation and be skilled in pedagogy to ensure that curriculum activities are blended in a way that the content of instruction is understood by students within active learning time. The teacher's level of competence affects his/her delivery in terms of the ability to plan coherent and progressive teaching time that matches students' needs and abilities. Also, the teacher should be able to justify what is to be taught.

The teacher is expected to help others to acquire knowledge, competences and values. Consistent finds indicate that teachers with high PCK facilitate learning in a more engaging and dynamic manner, whereas teachers with low CK might avoid the more challenging parts of the curriculum. There is therefore the need for rigorous assessment on the effectiveness of professional development of teachers because it is only effective professional development that can help them become more competent in handling the subjects they teach. Professional competence demands that both teachers' content knowledge and pedagogical knowledge be improved simultaneously to ultimately increase achievement among their students.

Conclusion

The centrality of PCK in education stems from the significance of promoting a good balance between what the teacher knows (content) and ability to teach (pedagogy) the subject matter in ways that optimize learner achievement. The discourse of PCK has produced several models since Shulman's proposed the framework to benchmarking teacher professional knowledge in 1986. What is most important, however, is that the cultivation and nurturing of PCK is a continuous learning process for teachers, beginning from initial teacher education. Other variables such as the nature of the curriculum, parental home influence and the socio-economic and political environment which affect educational decisions cannot be totally wished away within the context of PCK application. What is most important, however, is that professional teachers must evolve their own mechanism for surmounting likely obstacles through such

avenues as subject teachers' association, trade union participation and ceaseless engagement with other stakeholders in the business of education at the level where they operate.

References

Adu, E. O. (2014). Teacher's pedagogical content knowledge and its implications for effective resource-based science instruction in Nigerian Senior Secondary Schools. *Creative Education*, 5(6), 517.

Atieno, O. R. (2022). Teacher education students' pedagogical content knowledge: Retooling the professional development process in Kenya's Schools of Education. *African Journal of Teacher Education: A Journal of Spread Corporation*, 11 (1), 27-55.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59, 389-407 <http://jte.sagepub.com/cgi/content/abstract/59/5/389>

Blomeke, S., Olsen, R. V., & Suhl, U. (2016). Relation of student achievement to the quality of their teachers and instructional quality. In T. Nilson & J. Gustafsson (Eds.), *Teacher quality, instructional quality and student outcomes: Relationships across countries, cohorts and time* (pp. 21-50). Springer.

Carlsen, W. (1999). Domains of teacher knowledge. In J. Gess-Newsome & N. G. Lederman (Eds.), *PCK and science education* (133-144). Netherlands: Kluwer Academic Publishers.

Carlson, J., & Daehler, K. (2019). The refined consensus model of pedagogical content knowledge in science education. In A. Hume, R. Cooper, & A. Borowski (Eds.), *Repositioning pedagogical content knowledge in teachers' professional knowledge for teaching science* (pp. 77-94). Springer.

Cochran, K. F., King, R. A., & DeRuiter, J. A. (1991). Pedagogical content knowledge: A Tentative Model for Teacher Preparation. Paper presented at the annual meeting of the American Educational Research Association, Chicago, April, 1991

Gess-Newsome, J. (1999). Pedagogical Content knowledge: an introduction and orientation. In: Gess-Newsome, J.; Lederman, N.G. (Eds.),

Examining pedagogical content knowledge, Dordrecht, The Netherlands: Kluwer Academic Publishers, 3-17.

Grossman, P. L., Wilson, S. M., & Shulman, L. S. (1989). Teachers of substance: Subject matter knowledge for teaching. In M. C. Reynolds (Ed.), *Knowledge base for the beginning teacher* (pp. 23-36). New York: Pergamon

IBE-UNESCO (2017). *Training tools for curriculum development: Developing and implementing curriculum frameworks*. Geneva: International Bureau of Education/United Nations Educational, Scientific and Cultural Organisation.

Jacob, F., John, S., & Gwany, D. M. (2020). Teachers' pedagogical content knowledge and students' academic achievement: A theoretical overview. *Journal of Global Research in Education and Social Science* 14, 2, 14-44.

Ling, P. M., & Mahmud, M. S. (2023). Pedagogical content knowledge on primary school mathematics teachers based on specialization. *International Journal of Academic Research in Progressive Education and Development*, 12(2), 1033–1048.

Mafa-Theledi, O. N. (2024). Teachers' pedagogical content knowledge and subject matter content knowledge: Is the framework still relevant in teaching of STEM. *International Journal of Research and Innovation in Social Science (IJRISS)*, VIII, IV, 836-846.

Morine-Dersimer, G. & Kent, T. (1999). The complex nature and sources of teachers' pedagogical knowledge. In J. Gess-Newsome & N. G. Lederman (Eds.), *PCK and science education* (21-50). Netherlands: Kluwer Academic Publishers

Hwang, N. & Kisida, B. (2021). Spread Too Thin: The Effects of Teacher Specialization on Student Achievement. (EdWorkingPaper: 21-477). Retrieved from Annenberg Institute at Brown University: <https://doi.org/10.26300/616s-he51>.

Nortvedt, G. A. & Gustafson, J. (2016). The importance of instructional quality for the relation between achievement in reading and mathematics. In T. Nilsen & J. Gustafsson (Eds.), *Teacher quality, instructional quality and student outcomes: Relationships across countries, cohorts and time* (pp. 97-114). Springer.

Olufsen, M., Karlsen, S., Sæleset, J., & Thorvaldsen, S. (2021). The impact of

specialised content courses on student teaching in a Norwegian teacher education programme, *Education Inquiry*.
<https://doi.org/10.1080/20004508.2021.1892908>

Scherer, S. & Nilsen, T. (2016). The relations among school climate, instructional quality, achievement motivation in mathematics. In T. Nilsen & J. Gustafsson (Eds.), *Teacher quality, instructional quality and student outcomes: Relationships across countries, cohorts and time* (pp. 51-80). Springer.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57, 1-22.

Suglo, E. K., Bornaa, C. S., Iddrisu, A. B., Atepore, S., Adams, F. X., & Owuba, L. A. (2023). Teacher's pedagogical content knowledge and students' academic performance in circle theorem. *Journal of Education and Teaching Methods*, 2, 3, 29–41.

Taylor, N. J., Carlson, J., Gardner, A. L., Wilson, C. D., & Sluhlsatz, M. A. (2016). Teacher pedagogical content knowledge, practice, and student achievement. *International Journal of Science Education*, 41, ISS47.

Umudi, B. A. (2018). Teacher pedagogical content knowledge as correlates of academic performance among students in upper basic school social studies in Delta State, Nigeria. *Journal of Teacher Perspective*, 13(1), 27-35.

UNESCO (2006). *Teachers and educational quality: Monitoring global needs for 2015*. Montreal: UNESCO Institute for Statistics.

UNESCO (2004). *Changing teaching practices using Curriculum*. UNESCO Digital Library

UNESCO (2021). *Changing teaching practices using Curriculum*. UNESCO Digital Library.

United Nations Educational, Scientific, Cultural Organization /United Nations Children's Fund (2007). *A human rights-based approach to education: A framework for the realization of children's right to education and rights in education*. Paris/New York: UNESCO & UNICEF.

U.S. Department of Education. (200). *Strengthening teacher education and licensing: A guide to the debate*. Washington, D.C.: Author

Van der Jagt, E. & Nielsen, W. (2024). Preservice primary teacher pedagogical content knowledge of fractions using the refined consensus model. In J. Višňovská, E. Ross, & S. Getenet (Eds.), *Surfing the waves of mathematics education. Proceedings of the 46th annual conference of the Mathematics Education Research Group of Australasia* (pp. 543–550). Gold Coast: MERGA.

Virginia Department of education, (2007). *Department of Education* <https://files.Eric.ed.gov>.