Educational Considerations

Volume 42
Number 1 *The Kansas State University Professional Development School Partnership*

Article 7

9-1-2014

The PDS Model as a Vehicle for Simultaneous Renewal in Mathematics Education

Sherri L. Martinie
Kansas State University

Chepina Rumsey
Kansas State University

David S. Allen
Kansas State University

See next page for additional authors

Recommended Citation

Martinie, Sherri L.; Rumsey, Chepina; Allen, David S.; Bennett, Andrew; Abernathy, Deborah; Zolnerowich, Brandys; and Hancock, Melisa (2014) "The PDS Model as a Vehicle for Simultaneous Renewal in Mathematics Education," *Educational Considerations*: Vol. 42: No. 1. https://doi.org/10.4148/0146-9282.1043

The PDS Model as a Vehicle for Simultaneous Renewal in Mathematics Education

Authors

Sherri L. Martinie, Chepina Rumsey, David S. Allen, Andrew Bennett, Deborah Abernathy, Brandys Zolnerowich, and Melisa Hancock

The PDS Model as a Vehicle for Simultaneous Renewal in Mathematics Education

Sherri L. Martinie, Chepina Rumsey, and David S. Allen

Dr. Sherri Martinie, former public school teacher at the elementary, middle and high school levels, is a National Board Certified Teacher and Assistant Professor of Curriculum and Instruction at Kansas State University's College of Education. Dr. Martinie has been involved with the KSU PDS Partnership since 1999 as a graduate student, Graduate Teaching Assistant, cooperating teacher, university supervisor, and secondary mathematics teacher educator.

Dr. Chepina Rumsey, a former elementary school teacher, is Assistant Professor in the College of Education at Kansas State University. Dr. Rumsey has been a PDS participant, since she joined the Department of Curriculum and Instruction in 2012, through her work leading professional development and supervising undergraduate students in their field placements.

Dr. David S. Allen, Associate Professor and Director of Field Experiences, is a former elementary and middle school mathematics teacher and has been with the Department of Curriculum and Instruction for 14 years. Prior to assuming the duties associated with the Office of Field Experiences, Dr. Allen worked closely with the KSU PDS in the role of a faculty liaison through which he provided professional guidance in the area of mathematics.

(The authors would like to acknowledge the valuable insights and contributions of Andrew Bennett, Professor and Department Head of Mathematics; Deborah Abernathy, mathematics teacher and cooperating teacher; Brandys Zolnerowich, teacher and clinical instructor; and Melisa Hancock, Teacher in Residence and former cooperating teacher and clinical instructor)

For a quarter century, Kansas State University's College of Education has supported a Professional Development School (PDS) model involving professional collaboration with selected public school systems across Kansas. In that time, this relationship has proved to be an instrumental vehicle for educational change. According to John Goodlad, educational change has created a dilemma: "What comes first, good schools or good teacher education programs?" (1994, p 1). Goodlad's solution to this dilemma is to improve both at the same time. "There must be a continuous process of educational renewal in which colleges and universities, the traditional producers of teachers, join schools, the recipients of the products, as equal partners in the simultaneous renewal of schooling and the education of educators" (Goodlad, 1994, p. 1-2). This process of simultaneous renewal has become a feature of the PDS model at Kansas State University (KSU) and education reform in mathematics is just one of several content areas impacted by the PDS model. One strength of the model is the ability to impact participants across the educational continuum–connecting university faculty and staff, clinical instructors, in-service teachers, preservice teachers, and K-12 students. Currently, efforts in mathematics education are focused on Kansas' implementation of the *Common Core State Standards for Mathematics* (CCSS-M) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

The state of Kansas' adoption and school districts' subsequent implementation of the CCSS, specifically the mathematics standards (CCSS-M), have infused KSU's PDS model with added enthusiasm and vitality by engaging participants in a coherent conversation about teaching. The expectations for both what is taught and how mathematics is taught have shifted. A challenge for in-service teachers as they transition to the CCSS-M is that they can't simply wipe the slate clean and remove the previous standard expectations. Many teachers have perfected their lesson plans, units, and courses of study around the retired standards; throwing that familiarity out and starting over is a daunting task. This is where preservice teachers are a valuable resource for in-service teachers, and the PDS model provides an appropriate

framework for facilitating change. Preservice teachers have been trained by university faculty and staff using the newly adopted CCSS-M. University faculty and staff are working intently to make sense of the standards themselves and also to design new professional development experiences for both preservice and in-service teachers. Understanding where teachers are in the transition process and what they need along the way will heighten the impact of those experiences. This paper focuses on just one of many disciplines within the PDS model to discuss how the PDS model promotes simultaneous renewal in mathematics education.

The PDS Framework

A number of dynamic relationships exists within the framework of the PDS in the College of Education at KSU (see figure 1). The main roles in the Kansas State University Supervision Model include: student teacher, cooperating teacher, clinical instructor, university supervisor, and K-12 students. When specifically addressing the teaching and learning of mathematics, this framework extends beyond training preservice teachers. Mathematics educators work extensively with in-service teachers who often serve as cooperating teachers or mentors for preservice teachers. The team also extends beyond the College of Education to include faculty in the Mathematics Department, post-doctoral fellows, and graduate students. Deep and meaningful interactions occur among the various roles indicated in this framework, as explained and highlighted in the next section of this paper.

The roles in the KSU PDS include the following:

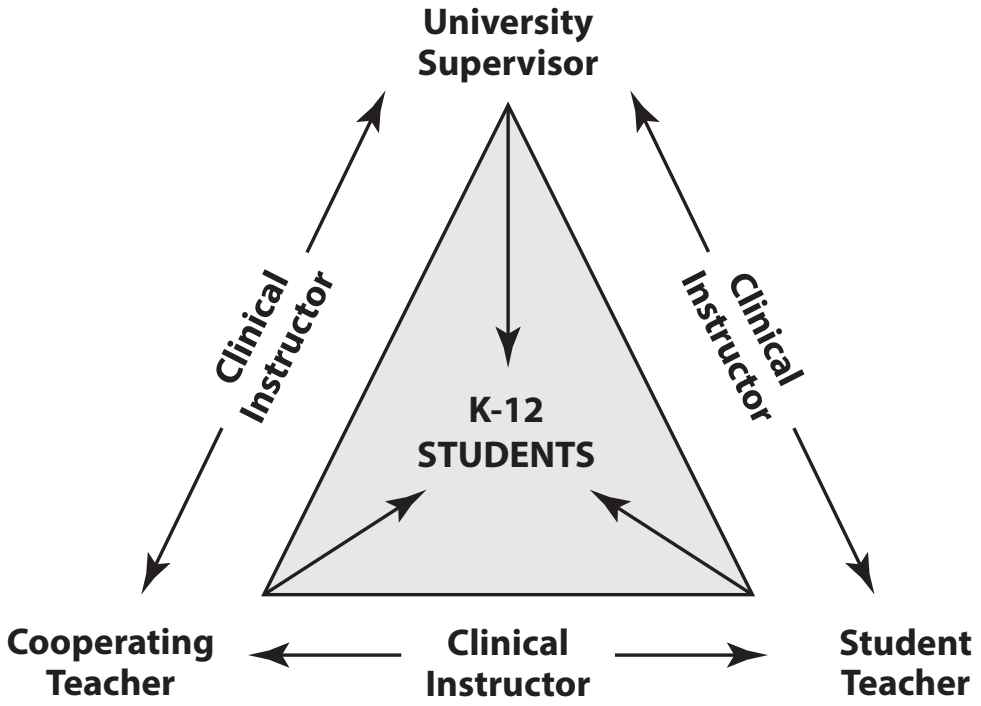
Clinical Instructor

As stated in the *Kansas State University Professional Development School Handbook* (2014), the clinical instructor (CI) coordinates several efforts within the schools. The CI coordinates all PDS activities and field experiences. In this capacity, s/he coordinates placements, provides orientation for field experience students and PDS faculty, conducts student intern seminars, and troubleshoots when necessary. The CIs maintain communication among interns, PDS teachers, administrators, parents, students, KSU faculty, and other clinical instructors. By facilitating and participating in various programs and projects, they promote professional development and school improvement activities at each PDS and align these activities with other district and building improvement efforts. Finally, they coordinate PDS program evaluation. This is done through annual assessments of the impact of the PDS.

University Supervisor

The *Kansas State University Professional Development School Handbook* states that the university supervisors and clinical instructors collaborate to complete a number of tasks. In general, supervisors and CIs work together to assist preservice teachers by ensuring they have an optimal learning experience during their time in the PDS schools. University supervisors are instructors of the content-specific methods courses; this enables them to build relationships and train

Figure 1 | **Kansas State University Supervision Model**



https://newprairiepress.org/edconsiderations/vol42/iss1/7
DOI: 10.4148/0146-9282.1043

preservice teachers prior to their internship experience and continue this work during the internship. University supervisors guide preservice and in-service teachers to integrate theory from professional studies with practice in clinical settings through conferences with them and their cooperating teachers.

Cooperating Teachers

Cooperating teachers act as mentors and teacher educators to preservice teachers. They host preservice teachers in the classroom during various field experiences, including student teaching. Two approaches advocated by the COE are co-teaching and coaching.

Campus Content Faculty

As stated earlier, work in mathematics education extends beyond the roles within the College of Education supervision model to include faculty in the Department of Mathematics. University supervisors and campus content faculty collaborate to develop a strong foundation of content knowledge and pedagogical content knowledge. Many preservice teachers earn dual degrees; they often earn a degree in secondary education and a degree in mathematics. Doing this requires carefully preparing a well-designed program of study to fulfill requirements for both degrees. The ability to do this has been strengthened by bringing together the advisors from the COE and the Department of Mathematics. Relationship between mathematics faculty and COE faculty is strengthened by a long history of funding through state-level Mathematics Science Partnership (MSP) grants and successful implementation of projects with in-service teachers. The MSP grants also bring in graduate students and post-doctoral fellows from the mathematics department to assist in delivering mathematics content courses to in-service teachers.

The PDS Focus on the CCSS-M

The College of Education at KSU has both an opportunity and a responsibility to assist teachers in the change process required for the CCSS-M. Based on the vision of the KSU PDS model, the work of the partnership is embedded within a cycle of continuous improvement. The newest reforms–adopting and implementing new mathematics standards–exemplify this process in action. Using the CCSS-M implementation as an example, the following sections will address the responsibilities stated in the mission of the PDS model that the participants share:

- preparation of new teachers
- continuing professional development
- support of children's learning
- practice based inquiry

As one teacher stated, "I am grateful that other professionals (specifically those from KSU) are working out the details of how to implement the CCSS and then sharing that research with teachers through professional development and through graduate coursework." By emphasizing the CCSS-M in coursework for undergraduates, the COE at KSU is sending preservice teachers into the field with a strong sense of the shifts in instruction and a better understanding of the standards themselves. According to one cooperating teacher, "It has been so easy to work with those students in my classroom because they are already prepared to help scaffold my high school math students who are experiencing this major upheaval." The PDS model makes the inclusion of preservice teachers routine; therefore, integrating them into the classroom is rarely a disruption. This is important at a time when many teachers believe that the teaching and learning of mathematics is not a smooth and clear path.

In light of the newly adopted CCSS for mathematics, the PDS model was rejuvenated to support preservice teachers, teachers, mathematics educators, and mathematicians to promote mathematics education through collaboration and ongoing professional development. We acknowledge and respect the notion that teaching takes a much higher level of understanding than is necessary for the normal mathematically functioning adult. As Ball, Hill, and Bass (2005) point out, "Teachers do not merely do problems while students watch. They must explain, listen, and examine student work. They must choose useful models or examples. Doing these things requires additional mathematical insight and understanding" (p 17). Teachers must have a specialized "pedagogical content knowledge" (Shulman, 1986). Research suggests that professional development projects must facilitate a shift in the way teachers view mathematics and how they approach the teaching and learning of mathematics, and the best place to do this is in the classroom.

The Dynamic Relationships within the Framework

Preparation of New Teachers

During their methods course and practicum experience prior to their internship, preservice teachers practice creating lessons and units aligned to the CCSS-M. For example, preservice teachers begin by looking at the standards as a "whole." To familiarize themselves with the mathematics they will teach, preservice teachers use learning progression documents that highlight "critical areas" for each grade level, and (specific to the high school) they use documents that articulate "pathways" such as those found in Appendix A of the CCSS-M. Preservice teachers use this foundation to focus on a unit of study. Their practice of preparing lessons begins with understanding "clusters" of standards. They use the CCSS flipbook (http:// community.ksde.org/Default.aspx?tabid=5646) to "unpack" the standards and study the background knowledge. This background includes: examples of this standard from the perspective of what students in the classroom would do, recommended instructional strategies, Standards for Mathematical Practice that have the potential to align best, connections to other content standards, and student misconceptions. Preservice teachers also access the Illustrative Mathematics website (https://www.illustrativemathematics.org/) to see an exemplar task aligned to their standard. After familiarizing themselves with what this cluster of standards entails, they are ready to prepare lessons. Clearly, this process does not occur for every cluster of standards, but as it is done for several throughout the semester, preservice teachers develop a better understanding of the depth of knowledge expected by the standards, as well as a solid understanding of what it takes to really "know" a

cluster of standards. The preservice teachers then bring this experiential base with them to their internship experience.

While preservice teachers are in the field, they funnel valuable insight from the classroom perspective back to university faculty and staff. This is one example of how simultaneous renewal is fueled. This helps answer the question: "What do teachers, preservice and in-service, actually need to be able to do to effectively teach to the CCSS-M?" Depending on the school or district in which preservice teachers are placed, the focus on the CCSS-M can vary from an awareness level to a full-fledged implementation of content and practice standards. Some districts are taking advantage of this and making a "hard landing;" they are "fully implementing" the CCSS-M. At early stages of implementation, classroom teachers often feel they are scrambling for a better understanding of what the standards actually "mean." Some spend time exploring resources that can support them as they create units and write lessons. Preservice teachers are a valuable resource in this instance, as they have been trained in a process that will enable them to understand the standards and have resources they can share with their in-service teacher.

The preservice teacher is viewed as an additional knowledgeable adult in the classroom to help share the workload of researching, planning, and implementing new units and new lessons. While the preservice teacher offers insight on current knowledge, the in-service teacher offers an opportunity, a place, and an audience for moving the preservice teacher from theory to practice. Preservice teachers have studied the potential for classroom implementation and have worked to plan and prepare lessons; however, another layer of teaching involves enacting those plans with fidelity. The in-service teacher offers a venue for this to occur and support in the form of classroom management and discipline structures, as well as a deeper understanding of how students relate to the content in the classroom. This enables both preservice and in-service teachers to simultaneously improve their teaching practices related to mathematics.

This is where the role of the university faculty and staff in the PDS model becomes significant and the interactions between the classroom teacher and the university faculty and staff come into focus. The university faculty and staff have important interactions with preservice and in-service teachers; feeding this simultaneous renewal process is the transition to the CCSS-M. Both preservice and in-service teachers simultaneously participate in similar activities related to understanding and enacting the standards. The preservice teacher does this through the methods course and the accompanying practicum experience. The in-service teacher accomplishes this through professional development experiences, but ultimately this enables participants to share a common language and understanding so they can work together more efficiently. Through this model, both preservice and in-service teachers are often trained with the same resources in the preparation for the CCSS-M.

Central to all of these interactions that lead to improvements in teaching and learning mathematics is the role of the clinical instructor. Feet on the ground and in the trenches daily, the clinical instructor serves as a liaison for the intern, cooperating teacher, and the university supervisor. Through bi-monthly meetings with clinical instructors, the PDS provides on-going professional development. This information is then taken back to the schools, where the clinical instructor shares it with preservice and in-service teachers. The clinical instructor creates a bridge between the cooperating teacher and intern. Regularly scheduled seminars enable the student teacher to voice concerns, ask questions, and address specific needs. These seminars enable the clinical instructor to assist the intern as s/he integrates theory from professional studies with practice in clinical settings. The clinical instructor shares new needs that arise from working with cooperating teachers and interns with the COE, and the cycle continues.

Continuing Professional Development

The PDS model also provides a unique opportunity for professional development. Bi-monthly meetings between clinical instructors and university faculty and staff allow for a sharing of approaches and current research regarding education. In addition, Mathematics Science Partnership (MSP) projects are another means for meeting the need to prepare mentor teachers to work with preservice teachers. Examples of in-depth, continuous professional development stem from two Mathematics and Science Partnership Grants at KSU: Project QUEST and Project MILeS.

Project QUEST is a teacher leadership grant designed to increase student achievement through implementation of the CCSS-M content and practice standards, while also preparing mentor teachers to work with preservice teachers. A three-year grant, it begins with a two-week summer academy focusing on developing teacher leaders. During the morning sessions, the focus is on deepening content knowledge. Mathematicians from KSU deliver mathematics instruction to teachers. The afternoon sessions have a pedagogical focus, wherein teachers write an action plan that relates to the specific needs of their classroom, school, and/or district. Using a job-embedded professional development model, the grant employs a math coach to regularly follow up with project teachers, including regular site visits, observations, feedback, and dissemination of resources for teachers. These teacher leaders also move forward the professional development work related to the CCSS-M for their school/district; they often design and lead professional development experiences in their district. The mathematics education faculty provide research from the field and bring to the table ideas about how to structure and present information regarding the CCSS-M.

Project MILeS (Improving Mathematics Instruction through Lesson Study), a three-year grant project, targets five elementary schools from within the KSU-PDS partnership and neighboring schools. Similar to Project QUEST, Project MILeS combines an annual two-week summer professional development academy and ongoing participant support from a mathematics coach during the school year.

The math coach also co-teaches the elementary mathematics methods course with a mathematics education faculty member and principal investigator of Project

https://newprairiepress.org/edconsiderations/vol42/iss1/7
DOI: 10.4148/0146-9282.1043

MILeS, bringing information from the classrooms to the preservice teachers, and bringing new resources from the methods course to the schools. This project develops deeper mathematical content knowledge of preservice and in-service elementary school teachers, while guiding them in exploring pedagogical concerns related to the implementation of the content standards and Standards for Mathematical Practice outlined in the CCSS-M. The project also builds on the PDS partnership between elementary school teachers and KSU by strengthening the network of support for classroom teachers implementing the CCSS-M. By collaborating with content experts and mathematics educators at KSU, teachers have an opportunity to study authentic mathematics, the Standards for Mathematical Practice (especially mathematical argumentation and discourse), and the CCSS-M content standards in a supportive learning community.

Support of Children's Learning

Central to the preparation of new teachers and continuing professional development described in the professional development projects are the implicit goals of improving children's learning and the implementation of practice-based inquiry teaching, exemplified in the CCSS-M. Preservice teachers give a pretest and posttest for a unit of study they have designed during their internship. In all cases, interns find significant gains in student learning. The student data is collected, analyzed, and reported in the intern portfolio. Related to in-service teacher professional development, one requirement of Project QUEST participants is to write an action plan specific to the student needs in their classroom. Teachers collect pretest and posttest data that indicate an increase in teacher content knowledge and a focus on specific pedagogical strategies improves student learning. Specific to Project MILeS, the mathematics coach supports teachers as they implement the professional development model of Lesson Study (Nagasaki & Becker, 1993), where teachers build on collaborations to improve both their content and pedagogical knowledge. This leads to long-term gains in teacher quality and thus gains in student achievement in mathematics as indicated by classroom assessments.

Practice-based Inquiry

There are several strong examples of practice-based inquiry in mathematics education. Teachers generate action plans through participation in Project QUEST, including data collection and analysis. Teacher action plans have examined the use of formative assessment, implementing Standards for Mathematical Practice, aligning content standards with curriculum materials, interventions for struggling learners, and facilitating classroom discussions. Teachers participating in Project MILeS develop lessons through lesson studies related to issues that are pertinent in their classrooms. One main focus is on integrating practice standards and content standards at the elementary level. In these ways, teachers are using practice-based inquiry to address student needs in their classroom or building.

An Example Across the Educational Continuum

One activity that exemplifies the coherence across the groups involved in the PDS partnership is related to an exploration about Depth of Knowledge (DOK) levels. The following activity is used with preservice elementary and secondary mathematics methods courses, the MSP summer academies for in-service K-12 teachers, and with district-wide professional development.

The DOK Levels were developed by Webb (2002) and describe the levels of cognitive demand needed for tasks. DOK level analysis can be applied in all subject areas and is well suited for mathematics. DOK levels are as follows:

- Level 1, "Recall and Reproduction," is characterized by facts, definitions, procedure following, and memorization.
- Level 2, "Skills and Concepts," requires classifying, comparing, and organizing, thus going beyond the rote procedures and memorization of DOK level 1.
- Level 3, "Strategic Thinking," requires reasoning, evidence gathering, explaining, and interpreting.
- Level 4, "Extended Thinking," is characterized by planning, developing, and synthesizing new ideas in complex ways.

The same task could be presented along a continuum of increasing complexity by studying and applying the DOK Levels, which have become an important feature of new assessments aligned with the CCSS-M.

The activity begins with a description of the DOK levels and the connections between CCSS-M and new state assessments. Looking at the DOK levels, groups discuss tasks. Then participants are given a set of tasks specific to their grade level and asked to sort the tasks based on the DOK level. A rich discussion results, as participants justify placing a task in a certain category. The goal is not to reach an exact consensus because there is room for interpretation; the discussion about what makes tasks a higher level is the goal of the activity. Using tasks from current assessments is beneficial because it helps preservice and in-service teachers become aware of the assessments aligned to the CCSS-M. The goal is to compare, contrast, apply, and justify understanding of the levels as participants discuss tasks and the student thinking those tasks will elicit, rather than for the preservice and in-service teachers to simply memorize the DOK levels.

> ***This [PDS Partnership] created a simultaneous renewal and reciprocal degree of mutual respect for the role each of us plays in the induction of new teachers.***
>
> – Dr. Larry Scharmann
>
> Former Professor, Secondary Education Department Chair, and Original Planning Team Member, College of Education, Kansas State University

Implications

The KSU PDS framework provides an opportunity to increase the content and pedagogical knowledge for both preservice teachers and in-service teachers in all subject areas. One result of the partnership is the exchange of ideas that results when practicum students and interns work with teachers and K-12 students. Cooperating teachers are exposed to new ways to teach topics…especially difficult ones. Interns have a chance to practice strategies and ideas they have been trained to use in authentic classroom situations. The framework of the partnership means the intern comes into contact with many people who both guide and oversee the progress of the KSU student.

Specific to content knowledge of in-service teachers, MSP grant work (described previously) has increased the content knowledge of teachers. During the history of the summer academies, project teachers take pre- and post-assessments related to the mathematics studied. Between the pre- and post-assessments, each teacher improved his/her math content score, showing that the participants' content knowledge was affected through instruction. In addition, as mathematics educators work with mathematicians to create the summer mathematics courses for teachers, mathematicians are developing a better sense of how mathematics for teachers is different than mathematics for mathematicians. The work to prepare the summer academies has an influence on the mathematicians who, in turn, teach the content courses for the preservice teachers.

Summary

KSU's PDS model is the foundation upon which work across the educational continuum is built. Reform efforts in mathematics education involve implementing change through the collaboration of a team of mathematicians, mathematics educators, principals, teachers, and undergraduates. The roles and responsibilities for the collaboration should be well articulated so that all stakeholders understand the key roles they play in this type of collaborative model.

Through the PDS model that KSU has developed over the past 25 years, the university mathematics faculty and staff have collaborated extensively with the clinical instructors, in-service teachers, and preservice teachers in Professional Development Schools. This has been especially evident–and beneficial–through their work regarding discussions and implementation of the CCSS-M. Based on this collaboration in mathematics, the PDS model and the relationships formed because of it demonstrate that great strides can be made in the field of education as all elements work together to improve the science and art of teaching, all for the benefit of K-12 students.

References

Ball, D.L., Hill, H. C., & Bass. H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide? *American Educator*, 29(1), 14-17, 20-22, 43-46.

Goodlad, J. (1995). *Educational renewal: Better teachers, better schools.* San Francisco: Jossey-Bass.

Kansas State University (2014). *Kansas State University professional development school handbook*. Retrieved from http://coe.k-state.edu/partners/pds/index.html

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics.* Washington, DC: Authors. http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf

Nagasaki, E., & Becker, J. P. (1993). Classroom assessment in Japanese mathematics education. In N. L. Webb (Ed.), *Assessment in the mathematics classroom.* 1993 Yearbook of the National Council of Teachers of Mathematics (pp. 42). Reston, VA: National Council of Teachers of Mathematics.

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

Webb, N. (2002). *Depth-of-knowledge levels for four content areas.* Retrieved from http://facstaff.wcer.wisc.edu/normw/All%20content%20areas%20%20DOK%20levels%2032802.pdf