



Beliefs about Learning, Instruction, and Technology among Elementary School Teachers

Nicole J. Kurz-McDowell and Robert D. Hannafin

Abstract

The current study investigated six teachers, three in second grade and three in fourth grade, and their beliefs about learning, instruction, and technology. The first significant finding was that the teachers who held objectivist notions about learning and instruction also held objectivist views concerning technology, and the teachers who possessed constructivist beliefs about learning and instruction also had constructivist beliefs about technology. The second major finding was that these second-grade and fourth-grade teachers differed in their beliefs about learning and instruction, as well as their beliefs concerning technology. The second-grade teachers placed greater emphasis on student-centered concerns while their fourth-grade colleagues were more teacher-centered. The difference in the beliefs and approaches to teaching at the primary and upper elementary grades may have implications for teacher preparation and inservice training efforts.

Elementary teachers go through a preparation program to ready them for teaching, including four-year programs, fifth-year programs, graduate programs, and alternative credential programs (Morey, Bezuk, & Chiero, 1997). These programs all share in providing their students “general knowledge, ... subject matter, ... professional education, ... including student teaching, ... pedagogical content knowledge, refer[ing] to the knowledge teachers need to represent and impart subject matter to students... [and] conceptual orientation” (pp. 6–8). Elementary teacher preparation programs may vary somewhat in content and structure, but most programs tend to adhere to a constructivist philosophy of teaching and learning. A “constructivist” philosophy, according to von Glasersfeld (1989), holds that newly learned information is uniquely altered by learners as it is assimilated into prior existing knowledge. This view contrasts with objectivism, which (Lakoff, 1987) holds that knowledge exists (objectively) outside of the mind in discrete chunks, and learning occurs when that knowledge is transmitted from a source (teacher) to destination (learner).

Cochran, DeRuiter, and King (1993) examined pedagogical content knowledge of beginning and experienced teachers. These researchers suggested that preservice teachers should be exposed to pedagogical content knowledge to enhance and develop constructivist approaches defined as “interpret(ing)... critically reflect(ing)... represent(ing) information (in multiple formats) ... adapt(ing)... tailor(ing)... flexible understanding” (p. 264). This inclusion would involve “conceptually integrated instruction, ... observ(ing) and reflect(ing) on one’s own teaching and that of others in a content area, ... (and) early, continued, and authentic field experiences with opportunities for real teaching and follow up reflection and feedback” (p. 269). Anderson and Piazza (1996) wrote about a change in the math courses at their university to move towards constructivist modes. These authors maintained that “preservice teachers have a limited personal experience with constructivist perspectives on learning... need a clear understanding... appropriate experiences and time to develop a philosophy” (p. 52). Anderson and Piazza argued, based on Bruner’s (1963, 1966) work, that “the purpose of education is to assist the student in learning how to obtain knowledge, not the memorization of a body of fact” (p. 51). Mintrop (2001) developed a constructivist program for preservice teachers based on Shulman’s (1987) model of “Fostering Communities of Teachers as Learners” (p. 208). Mintrop’s model followed “research-share-perform cycles” (p. 208).

Jonassen, Wilson, Wang, and Grabinger (1993) supported this integration of constructivist teaching, arguing that more meaningful higher order learning in most, if not all content domains, “is better supported by constructivist uses of production-rule expert systems” (p. 85). They included in expert rule systems “feedback facilitators, personal knowledge representation tools, and cognitive study tools” (p. 93). Feiman-Nemser (2001) extended the argument to include teachers through professional development. Instruction should begin at the preservice level but should be shaped to fit the needs of beginning and experienced teachers so these teachers can practice constructivism in their schools.

Preparing preservice teachers to integrate technology in ways that support that constructivist objective has been another goal of teacher preparation programs. Technology, mainly in the form of computers, is being touted in education as an instructional tool that will greatly aid teaching and learning. However, new teachers struggle in actually building student-centered environments with technology in their own classroom once they graduate. The Office of Technology Assessment (1995) reported that inexperienced teachers do not know how to merge technology and instruction in their classrooms. Teacher education programs need to better understand the factors that make that successful integration so challenging for their graduates.

Teachers' struggles to build constructivist environments may be tied to their beliefs about learning, instruction, and technology use. Those beliefs in turn may affect what the teacher does in the classroom. How these beliefs are formed may be based on a multitude of factors, including success or failure as a teacher in the classroom using different methods, experience as a student, and experiences with the cooperating teacher during student teaching. The teacher preparation program should include methods of helping preservice teachers develop student-centered approaches.

Constructivist Use of Technology

How technology, especially computers, is used or integrated is of critical concern to teacher educators, educational reformers, and other educators who subscribe to the benefits of student-centered learning environments. Educational reformers, such as Means (1994) and Kozma (1994), have argued that teaching and learning need to be transformed from the didactic, teacher-centered model into a more inquiry-based, student-centered approach. Technology, especially the computer, is seen as a critical tool to support this change in instruction by allowing and supporting inquiry and exploration by students. According to Means, technologies can be characterized as "they can tutor, they can explore, they can be applied as tools, and they can communicate" (p. 11). These functions can support constructivist teaching or they may support teacher-centered approaches; it is up to the teacher to decide how instruction will be handled in individual classrooms.

One study that showed individual teachers choosing and integrating technology in a constructivist manner was completed by Marcovitz, Hamza, and Farrow (2000). They looked at students and teachers in third- and fourth-grade elementary classrooms. Of the participants, one teacher had been using a computer for a few years, one teacher had been using a computer for nearly a year, and one teacher had just begun to use a computer. They found in this ethnographic study that students took on the support roles for each other in the forms of "playing, sharing, reading, small help, becoming expert, teaching" (p. 217). They reported that some of the responsibility for learning gradually shifted to the students. These results suggested that technology could support a naturally occurring shift in approach to learning and in the roles of teacher and student.

Saye (1997) also investigated actual classrooms, to study the role of technology with teachers and students in teacher-centered and student-centered settings. Saye examined teacher attitudes and practice in high school classrooms and developed interesting insight into the roles of teachers in objectivist (teacher-centered, didactic) and constructivist (student-centered) classrooms. The teachers in the study indicated that they thought of technology as a way for enrichment, control, and empowerment for students. However, teachers differed about whether they emphasized teacher control or student empowerment when using technology. Saye reported that teachers who used technology to reinforce traditional teacher-led practice sent a message to their students that this is the way instruction should take place. The students in turn supported this suggestion by saying that objectivist instruction is the way that teaching should take place. This suggests that teachers' beliefs may be long-lived and could be passed down to their students.

Teacher Beliefs in Learning and Instruction and Technology Integration

Teachers who match a belief system well rooted in constructivist teaching to technology use need to be explored. Becker and Riel (2000) analyzed "the relationship between teacher pedagogy and their use of computers in teaching" for teachers in grades four to twelve (p. 6). They organized the surveyed teachers into four categories: teacher leaders, teacher professionals, interactive teachers, or private practice teachers, based their philosophies as indicated on the TLC (Teaching, Learning, and Computing) survey. They found that teacher leaders and teacher professionals were "more likely than other teachers to see good teaching in terms of facilitating student inquiry rather than directly transmitting knowledge" and are more likely to emphasize "student engagement in learning and meaningfulness of content than to be concerned about disseminating a specific externally mandated curriculum to unmotivated students" (p. 14). The teacher leaders and teacher professionals also used computers more frequently than teachers in the other categories and used the computers for constructivist activities such as to communicate with others, "analyze data, and learn to work collaboratively" (p. 23). Becker and Riel created an additional category of teachers for exemplary computer use that was based on instructional use of software, professional use of computers, expertise, access to technologies by teachers, student use of computers in intricate projects, and change in computer use over time. They found that "teacher leaders were 10 times as likely as Private Practice Teachers to be designated as Exemplary Computer Users" (p. 25). However, Becker and Riel cautioned that the vast majority of teachers did not fall into either category.

Barriers to Constructivist Use of Technology

The focus on what prevents teachers from integrating technology needs to be examined closely. Ertmer (1999) examined the barriers that prevent teachers from integrating technology. She classi-

fied such barriers into two categories: first-order barriers that are external to the teacher, such as not having access to computers or training, or not having enough time to plan; and second-order barriers that are internal to the teacher, such as beliefs about educational practices. Ertmer suggested that technology integration had been focused on first-order barriers because they could be pinpointed and remedied easily, and there has been the assumption that once these barriers were overcome, technology integration would ensue. However, Ertmer argued that how teachers face first-order barriers seems to relate to second-order barriers. She suggested that second-order barriers, teaching philosophy in particular, might be the stronger limiting factor in predicting computer use to support constructivist approaches.

Ertmer, Addison, Lane, Ross, and Woods (1999) studied the relationship between first- and second-order barriers and technology use in practice. They surveyed, interviewed, and observed seven teachers in kindergarten, first, second, and multiage first- and second-grade elementary classrooms over a six-week time period. The participant teachers viewed technology as being "additional or supplementary to the existing curriculum," not as a way to explore new topics (p. 62). These teachers used technology for a variety of reasons. Seven teachers used it because it was "exciting and motivating," and six because "students needed to use technology to be prepared for the future" (p. 65). They found that the four teachers who described technology as a supplement "experienced more second-order barriers than the other teachers," suggesting that these teachers did not see the importance of technology use in relation to their education philosophies (p. 66).

In today's landscape, a significant barrier to technology integration might be the national trend toward greater teacher accountability and the curriculum pressures applied by the adoption of state-mandated standardized tests in elementary grades. The introduction of state-mandated standards and tests have surely affected the day-to-day instruction in the classroom. These tests often emphasize recall of individual facts instead of developing higher order thinking skills (Jonassen, 2000). McMillan, Mryan, and Workman (1999) reported that this encourages teachers to spend their time teaching specific facts to students so they can recite them back to the teacher. To cover all required content, teachers are forced to move quickly through material, whether or not all students have demonstrated understanding of the information. Students are being taught how to take tests, further reducing available class time. In short, the need to cover test material and test preparation clearly influence curriculum choices.

Preservice teachers must reconcile what they *hear* with what they *see*; they spend some of their time being trained in the insulated world of the college classroom and the rest of their time in the public schools observing teachers trying to strike the balance between sound pedagogical practice and the pressure to improve standardized test scores. This research study examines the beliefs about learning and instruction held by second- and fourth-grade teachers who had been teaching for a relatively short amount of

time, and attempts to identify any relationship between their beliefs and how they use technology. This study looks at if and how these teachers found such a balance between practice and pressure in using constructivist methods, including the use of technology, to support a student-centered environment.

The findings of this study may encourage followup examinations that further explore teachers' views about the interaction between curriculum and high-stakes state testing. Results from this study may also suggest critical components that seem to impede effective integration, at least for two specific grade levels. These findings have implications for preservice programs by identifying breakdowns between theory and practice. In addition, results from this study can be useful to in-service development. Professional development can also provide support and evidence to help teachers use technology to promote active student use. Finally, this study examines differences, both in philosophy and in practice, between second- and fourth-grade teachers, which have not been well researched.

There are several limitations to this study. The sample studied was taken from one school, in one school division with a unique culture and administration. No attempt was made to evaluate the myriad factors that influence the beliefs of this particular group of teachers. Further studies should look at least at two schools to begin to isolate elements that may be idiosyncratic. The present study examined teachers' beliefs in one moment of time. Additional studies should track changes in teachers' beliefs over long periods of time. One final limitation is that the primary investigator had been a member of the school community as a student teacher, which may have somewhat colored participant's responses, although we do not believe that to be the case.

Method

This study was conducted in a midsize public elementary school in a suburban town in a mid-Atlantic state. The school enrolled approximately 462 students in grades K–5, and had a decidedly bi-modal population with many upper-middle class families (about 50%), but at the same time with a significant number of families classified as lower-income. In the 2001–2002 school year, 22% of students at the tested school received free lunches, and another 17% received reduced-price lunches.

Participants and Setting

Six teachers participated in this study, three from second grade and three from the fourth grade. Five teachers were female. The teachers had an average of 6.7 years of teaching experience, ranging from 3 to 21 years, not including time substituting. Two teachers, one in second grade and one in fourth grade, taught in an "extended year" classroom. The extended year setup was designed to provide sustained support for students in the third ability quartile, 25–50%, i.e., students not at risk of retention, but who need additional assistance. The class size in the extended year classrooms is smaller, approximately 9–

15 students, and the school year started two weeks before the rest of the school and ended two weeks after. Another of the second-grade teachers taught in a multi-age first-grade/second-grade environment with a co-teacher; the participating teacher specialized in second grade, while the co-teacher specialized in first grade. Each teacher had her own classroom.

The lead author spent eight months prior to the beginning of this study in the school, five months as a methods student and three months as a student teacher in one of the participating fourth-grade teacher's classroom. In addition, she spent significant time observing one of the participating second-grade teachers and taught two lessons in that teacher's classroom. The lead author also observed one lesson in one of other fourth-grade teacher's classroom, and one lesson by one of other the second-grade teachers; she spent no time observing the remaining fourth- and second-grade teachers.

All of the second- and fourth-grade teachers (five in each grade) at the school were invited to participate in this study, but two from each grade declined. Pseudonyms are used throughout the report for all teachers. Following is a description of the participants:

Kelly: mid forties, has taught three years in the first-/second-grade classroom, and spent seven years substituting in multiple grades.

Maria: late twenties, has taught two years in second grade and three years in third grade.

Rebecca: mid forties, 19 years teaching second grade, one year teaching Kindergarten, one year teaching third-fourth grade combination class, and has been teaching for twenty-one years.

Melissa: early fifties, has taught two years in fourth grade and many years teaching preschool, first and second grades.

Robert: late twenties, has taught one year in first grade and four years in fourth grade.

Christina: early fifties, has taught four years in fourth grade.

There were four computers in each teacher's classroom. The teachers had limited access to Internet sites, depending on approval from the district central administration. The teachers could use county-approved software, and had access to Microsoft Office. There were at least two cameras stored at the school that could be reserved for teacher use.

Students in the fourth-grade teachers' classes were required to take a state-mandated standardized history test in May. Students in third grade were required to take state standardized tests in English, math, history, and science. Students in the second grade did not take a state exam.

Data Collection and Instruments

The teachers completed an open-ended question survey, designed by the primary investigator. (See Figure 1.) The participants were asked to complete the survey by the date of the interview. The survey consisted of nine open-ended questions related to technol-

Define technology: What would you like to learn about using technology? What kind of software do you use in your classroom? What are barriers to technology use in the classroom? Why do you use technology in the classroom? Do students benefit? What are the risks of using technology in the classroom? Define technology integration: When is technology use appropriate in the classroom? What are your goals for technology use in your classroom?

Figure 1. Survey Questions

ogy and technology use. Two teachers, one in each grade, did not have the survey completed by the date of the interview and completed the survey after the interview.

The teachers also responded to seven questions (See Figure 2) during an interview that lasted approximately 20–40 minutes. The interview questions related to teacher beliefs about learning and instruction. There were no questions related to technology in a deliberate effort to isolate beliefs about learning from practices related to technology, so that a possible relationship could be later studied. The interview was semi-structured, with the order and the wording of the questions being predetermined; six questions were the same for all the teachers and the seventh question asked for insight into the teacher's specific classroom structure: extended year, multi-age, or traditional. Teachers were allowed to interpret questions and answer how they felt was best. The investigator tried not to lead teachers in responding to the questions. Interviews were conducted in each teacher's classroom with only the teacher and first author present.

Survey and interview data were classified into patterns concerning beliefs about learning and instruction, and technology using the constant comparative measures. Teacher perspectives were judged and classified as consistent with either a student-centered or teacher-centered approach. For example, the statement made by Kelly that "... you have to find out what is going to interest them (the students), what are their interests and if you can do that I think you got them" was consistent with ideals commonly associated with student-centered learning, hence it was classified as such. Patterns of beliefs in instruction and technology use emerged within grade level and across grade levels.

Results

Results are presented in three sections. First, an overall picture of the second- and fourth-grade teachers is depicted. Then, a summary of teacher beliefs related to learning and instruction, especially those linked with planning and change in curriculum is offered. Finally, beliefs associated with technology, focusing on how these teachers defined technology and technology integration and how and why technology was used, are presented.

What is the goal or purpose of second or fourth grade?
 How do you plan for a lesson?
 How/When do you think students learn best?
 What makes you implement a change in the curriculum, if not mandated by others?
 How much do you feel you influence curriculum decisions?
 Has SOL testing affected your teaching? If so, how?

Figure 2. Interview Questions

Overall Picture

Second-grade teachers

The second-grade teachers expressed a strong desire to address student needs and adapt their teaching to those needs when planning and teaching. All three teachers expressed beliefs that tended to be consistent with a constructivist philosophy and depicted their classrooms as places where students were active participants. The teachers emphasized using technology and making changes in the classroom to fit individual students' needs. These teachers indicated that the goal of second grade was to help students become strong readers, with good fluency, word recognition, and comprehension. These teachers did not want their students to leave second grade without being able to read well.

These constructivist tendencies were evident in the teachers' responses to the instrument questions. Kelly, for example, stated that what she wanted to learn was "more useful applications to create hands-on learning for students" with technology. Maria stressed that students learn best "when they are actively involved, . . . if they are passive learners . . . I don't think they are learning as much. They need to be actively involved and engaged in what they are doing."

Fourth-grade teachers

The fourth-grade teachers, on the other hand, were somewhat conflicted. They espoused some ideas consistent with a more constructivist philosophy, but were quite settled in a teacher-centered routine. These teachers portrayed their classrooms as places where the Virginia Standards of Learning drove all activity and where their goals and needs (perhaps unintentionally) superceded those of the students. Two teachers spoke about fourth grade as being a transition to the intermediate grades in middle school, where students would need to be more independent. Melissa stated that "I think that you are helping them make an emotional jump too because before, you know, everything (in elementary school) is kind of small group and very nurturing and then they kind of just get hit by this wall of content and testing."

The fourth-grade teachers were very focused on covering the state standards. They did not feel they were able to add what they want (to make it fun) and were pressured by the state testing. Melissa stated that "I think I have all these books and wonderful ideas that I would like to add, and yet I don't feel like I have time to do them. I can't do different activities that I think kids would really grow from, (because) I have to get through those (state objectives)."

Learning and Instruction

Second-grade teachers

The second-grade teachers bridged curriculum to students and found ways to relate the curriculum to their students, rather than the other way around. For example, Kelly used books so that "the kids can really sort of put themselves there." Kelly suggests that she wants the students to form their own perspective about the material. She used books to help students construct their learning. Maria stated that, "I look at the SOLs (Virginia Standards of Learning) and I start with that and I think what can I do, you know, to enhance this to make them (the students) excited about it. Is there anything hands-on I can do with them?" When asked how and when students learn best, the second-grade teachers frequently mentioned that students should be active and involved in hands-on activities. Kelly stressed the importance of inquiry, finding the students' interests, and teaching to students' appropriate level. Maria and Rebecca too, believed that students need to be active and have ownership of their work.

A shared philosophy of learning emerged from their descriptions of how they plan for a lesson. Kelly stated that when she is planning a lesson she starts with a book, then "I try to enrich it with a hands-on activity . . . videos allow the kids to get to see things maybe they haven't develop the background." Rebecca planned depending on what the students need. Maria began planning with the standards of learning, but tried to find a way to get the students enthused about the subject.

Fourth-grade teachers

The fourth-grade teachers' practices were decidedly more teacher-centered. When asked how and when students learn best, Melissa replied that she preferred that students "learn by doing it themselves. The time I'm the happiest in here as a teacher is when they are working in their small groups with a project they are doing, a poster or a model where they're actually doing something." Yet, she did not feel that strategy was an option with her current class because of potential behavior problems. Robert stated that sometimes learning "kind of depends on the student." He conveyed in the interview that teachers should set an appropriate level for the student, not too high or too low. However, Robert also believed that students learn best "when their energy level doesn't interfere with them being able to focus" possibly revealing a belief that students should conform to the teacher's needs.

In describing how she plans for a lesson, Melissa stated that she "considers the group I have and what type of learning styles they have," adding that during a lesson she will either use manipulatives or draw a picture diagram of it. But then she went on to say almost apologetically, "but it's kind of like a demonstration, lecture kind of thing. And that they will probably do like a practice of that." Melissa indicated that "I'd like it to have more of a discovery approach, but I haven't found that in the classes I teach to be the way to go all the time." Robert planned based around the state standards of learning: "I make sure that I cover them, but turn

them into something fun and creative ... because if kids are not having fun they just get turned off to learning.” Robert also stressed that he taught what he found to be fun. When asked if he believed that he influences curriculum decisions he responded that “I think I change it (the curriculum) to fit what I enjoy teaching, but I also make sure that I do cover what is expected, just to have more fun in certain units.”

High-Stakes Testing and the Curriculum

All the teachers agreed that they are influenced by the state-mandated tests. At the time of this study there were no state tests in the second grade and one social studies test in the fourth grade. Interestingly however, students in third grade took no fewer than four SOL exams.

Second-grade teachers

The second-grade teachers all felt their teaching was influenced by the state tests because of the need to lay the groundwork for third grade. Kelly believed that she needed to get her students ready for the state tests in third grade by making sure that her students could “really read well on those tests, be able to extract information, (and) be able to summarize.” Rebecca reported that she no longer had time to do some fun activities, like cooking and crafts, because there is so much to cover.

When asked about making changes in the curriculum when not mandated by others to do so, the second-grade teachers emphasized finding students’ needs and making a match. Kelly spoke about bringing in another topic that she is excited about and that relates to a particular SOL. She also stated that she makes a change when “I see the kids are not grasping it then I would look for another direction ... when I don’t see that it’s meeting the needs of the students.” Maria echoed this sentiment: “You gauge your students somehow, you look at your students and see ... it all depends on your class and your students, I think, the individual needs.” Rebecca also affirmed that she makes a change “if it’s not working for the children.”

Fourth-grade teachers

The fourth-grade teachers reiterated the notion that they need to “cover specific things” and that “time is a pressure.” Melissa pointed out that the standards “give [me] a path to follow” but they also “make it difficult for me because I feel like I am moving on before I have all the children able to do it. And I can’t stop and wait because then we are not on track, so that the pacing of how I teach has changed because of it.” Robert added “I am forced to teach to the test ... I don’t enjoy it sometimes because I think the kids aren’t really getting the big picture.” Christina observed that fourth-grade teachers “probably spend more time working on history than they would otherwise, because of that test. Even to the detriment to other subjects.”

The fourth-grade teachers tended to follow the state curriculum more closely, although Melissa and Robert did tweak it from time to time. Melissa reported, “there are so many things we have

to cover that I don’t really have time to go into (additional) things. [But] occasionally I digress from the curriculum when I find some important information that is not really what we are talking about but is a wonderful link and that might help them next year, or might be something that they had in the past.” Robert also branched off from the curriculum: “Sometimes I get into certain units more than others. I enjoy teaching plants...I like to teach animals and living systems unit, ...so my philosophy is to teach these kids so that in the future they will protect the environment more, ...bring in what I think is important for the real world.” Christina made changes only when those who design the curriculum told her that there was a change: “everything that I do is with the (state) curriculum, and when they change the curriculum, I have to change.”

Curriculum Decisions

Second- and Fourth-grade teachers

Neither the second- nor fourth-grade teachers believed that they had much influence over curriculum decisions. The exception was Kelly (a second-grade teacher), because she was on the curriculum committee at the school; she felt she had more control on curriculum decisions, “on the committee, I feel like I am being asked if the curriculum is meeting the needs of our students. So it’s a way of asking the teacher who is in the classroom every day...is this what the kids really need?” Melissa, a fourth-grade teacher, was also on the school curriculum committee at the school level but felt less empowered. “I don’t think we have much leeway in determining what is being taught at which grade level, just how it is being taught.” Second-grade teacher Maria and fourth-grade teacher Christina, on the other hand, believed that they have absolutely no influence on the curriculum. Maria felt that committees make the curriculum and “I think it’s kind of driven by, you know, this is what they need to know and they are going to be tested on this.” Christina felt that the curriculum is handed down, preventing her from doing what she wants.

Efforts by Rebecca and Robert to change the curriculum indicated that although they believed they could not change the curriculum, there was room for flexibility. Rebecca, at the second-grade level, believed that she could “put my style in with what the county wants, so it will work for me.” Robert, at the fourth-grade level, indicated that he does influence the curriculum by being able to bring other things in to teach and to end a topic when he feels the students are no longer having fun with it.

Technology Beliefs: Different Definitions

Second-grade teachers

When asked to define technology on the survey, the second-grade teachers described how it was used, with examples of specific tools. For example, Kelly defined technology as “a process that improves productivity. In the classroom, technology provides [for us]... more in depth information (via the Internet) publishing process, (beyond the written copy) and video/laser disk recordings.” Maria defined technology as

"multimedia computers (video, interactive voice, sound), classroom software, Internet, cameras, VCR, DVD, a tool or instrument that helps to organize and accomplish specific tasks." In addition, when the second-grade teachers were asked to define technology integration they wrote in broad terms to include anytime that would benefit student learning. Kelly wrote "using computers, laserdiscs, video, etc., to aid in the instruction and learning of students," and Maria penned "combining subjects with a form of technology to enhance curriculum and classroom instruction."

Fourth-grade teachers

The fourth-grade teachers' definition of technology was similar to that of their second-grade colleagues. Melissa and Christina provided a list of terms: "the use of different media: computer, overheads, tape players, video, laser discs, LCD projectors and software, Internet." Christina added, "I suppose one could include T.V., videos, CDs and the like too." They described technology integration in terms of what to do, for example "using the computer as part of the lesson." However, Christina did add that teachers should "use other technological devices and programs to support what is accomplished in the classroom."

Technology Use

Second-grade teachers

Second-grade teachers used technology to supplement the curriculum and as tools for student learning. They tended to describe technology use from the student's perspective. Maria said she used technology "to enhance lessons, capture student attention, to show effective use of technology to students." Kelly stated that she used technology to "publish students' work during the last step in writing process. Researching or furthering interest in subjects discussed by exploring the Internet; skill and drill." Maria added that technology could be used "almost anytime where . . . students can create pictures, stories, projects. . . it reaches all learning styles." Kelly wrote that technology should be used "whenever it can be used effectively to provide an enriching opportunity for students to better understand a topic."

The second-grade teachers reported that the major risk with using technology was that it was not always dependable. For example, Kelly wrote that a risk of using technology in the classroom included "system failure (network)." Maria wrote that she felt a risk was that "sometimes it (technology) does not function properly." Kelly and Maria both added that it does not provide all the assistance a student may need, and that students need a great deal of time to type. Kelly stressed that technology should support student-centered and hands-on learning; Maria emphasized that she wants students to learn how to use the technology.

Fourth-grade teachers

Technology use reported by the fourth-grade teachers varied. Melissa used computers to help with remedial work and during free time. She lamented that she would like to use computers more for student use, especially "methods for students to access data

they need, animation techniques, moviemaking, editing." Robert has used technology as "an extra tool to help foster learning." In addition, he used it to develop student technology skills. Robert also wrote that he wanted to learn about grading programs. Christina used it because she felt that "students often react well to various forms of technology and I believe students benefit." Christina wrote about using her laptop daily, especially "to prepare materials for class," also emphasizing using technology for productivity gains. The fourth-grade teachers agreed that technology use was appropriate if it supplemented the curriculum.

Each fourth-grade teacher wrote that he or she felt inappropriate use of the Internet was a major risk of using technology. Additional risks, according to Christina, included loss of personal interaction, relying too heavily on technology, and not assessing its value before use. These teachers also listed varied goals for technology use. Melissa stressed that she wanted students to learn computer skills. It was unclear in Robert's goals for technology to "use more HyperStudio program units, and type more units" if he or the students would be actively involved. Christina wanted to develop more presentations to "replace some of my direct instruction," create review and test materials, and create "CDs that have selected Internet sites for students," suggesting that the sites and information would be pre-selected and the students would only read the information, not search it out themselves.

Second-grade teachers were more constructivist than their fourth-grade counterparts both in their attitudes and reported practices. Kelly was the strongest advocate for allowing students to control over their learning and seemed to use technology support that effort. Maria expressed a similar commitment but it was not as apparent if her students would use technology to control and manage their own learning. What was clear was Maria's focus on addressing student needs.

Summary of Second and Fourth-Grade Teachers Related to Beliefs about Learning and Instruction, and Technology Integration

The fourth-grade teachers' beliefs about learning and instruction were fairly consistent with how they used technology. They seemed more comfortable leading teacher-directed learning activities and used technology to help them do it. These teachers had a much stronger need for students to use computers to learn technology skills, rather than to enhance learning content. Melissa expressed interest in pursuing activities that were more student centered. However, she admitted that her current practices reflected a more teacher-driven approach. Robert attempted to motivate and interest students with relevant topics, but there was also a hint that he needed to control the process to some degree. Christina described her teaching philosophy as strongly student centered, yet her self-reported practice was decidedly teacher-centered. There was little evidence to suggest that the fourth-grade teachers use technology to support active student-directed learning, with inquiry and student ownership.

Beliefs about learning and instruction also seemed to drive the technology tools these teachers used. The second-grade teachers indicated that they used programs that support student construction and development such as Storybook Weaver, Write and Play, Reading Mansion, and Countdown Carnival. The fourth-grade teachers used more prescriptive programs such as Accelerated Reader. This confirms what may seem obvious: that the type of software teachers use matches their belief systems. The second-grade teachers gravitated toward more open student-centered software, while the fourth-grade teachers did not. This suggests that belief systems must be changed before we can expect technology to be used to facilitate innovative student-centered learning.

Discussion

Two clear patterns emerged: (1) a relationship exists between these teachers' beliefs about learning and instruction and their views about technology use; and (2) these second-grade and fourth-grade teachers differ, both in terms of philosophies and technology use.

The first finding suggested here is that beliefs in learning and instruction do indeed align with technology for these teachers. But there is surprisingly little confirmation of this relationship in the literature. This current finding does seem to confirm Saye's (1997) assertion that teachers who expressed constructivist views in learning and instruction also tended to use technology in student-centered ways, while conversely, teachers who had teacher-centered views about learning and instruction tended to use technology in ways that allow them to stay in their comfort zone.

The more striking finding is that the beliefs of these participating second-grade teachers differed markedly from those expressed by their fourth-grade colleagues in this study. The studied second-grade teachers tended to have student-centric beliefs and practices. They seemed more interested in having children be part of their instruction as active participants. All of the participant teachers indicated that they change their approaches according to the current students' needs, but it was much more evident with the second-grade teachers. This focus on student-active methods was also apparent in the second-grade teachers' attitudes toward technology. The investigated second-grade teachers seemed more likely to use technology to support student-centered environments.

The fourth-grade teachers were much more interested in covering content and their own needs and interests. Interestingly, Melissa, the most student-centered fourth-grade teacher, once taught at the preschool and at the first- and second-grade levels. She also taught in an extended year classroom, which may have required her to focus more on individual student needs. The fourth-grade teachers tended to focus on using technology so that students could learn technological skills, and to increase teacher productivity.

The question that arises is why would such philosophical differences exist? Teacher educators have observed this phenomenon for years, but have been unable to explain it with any certainty. The question asks if approaches to teaching are driven by nature, nurture, or a blending of both. It seems reasonable that students

with certain philosophies are drawn to one level or another, being essentially predisposed one way or the other. However, the influence of teacher preparation on philosophies must also be considered. One must ask if teacher preparation is so drastically distinct at various grades to lead to differences in teaching approaches. In addition, one must question whether, if these differences are present, they are desirable, or even intentional.

Certainly the differences between second- and fourth-grade teachers were not on the order of magnitude one might expect when comparing secondary vs. elementary. Yet, we did not expect the differences to be so pronounced. Other factors might help explain this phenomenon. The difference might suggest that there is a tacit difference in expectations and approaches at different grades. It certainly could be an artifact of this principal or school district, i.e., teachers with similar dispositions are hired to teach the same grade, in particular, an SOL exam grade. Principals need their schools to perform well on the state exams and likely put the teachers who are most effective at teaching to the test in the test grades (second grade is not tested). Or it may be that teachers with certain beliefs are drawn to teach certain grades. There is no reason to believe that fourth grade must be taught from an objectivist view, yet these three teachers all articulated such beliefs and practices, even though they were almost apologetic for their views. There is little doubt that student creativity, sense of wonder, and natural curiosity ebbs as they grow and mature through our schools. These findings cause one to ask: how much of that is attributable to the natural maturation process and how much is caused by our schools' needs to focus and prepare students for the "real world" of standardized testing. In addition, the concerns of imposing a single focus of education are raised, along with long-term impacts of state-standardized test. Finally, implications for teacher preparation are brought up as major concerns in this test-focused environment.

Future research might examine teachers who taught before and after state testing was implemented to see if there are any changes in beliefs and practice because of testing. Future studies should also confirm teacher-reported beliefs with what the teacher is actually doing in the classroom. Sustained observations over many sessions might confirm or challenge relationships between beliefs and practices. Other studies may track teachers over time to measure changes in their beliefs and practices.

This study raises bigger questions. Future studies should examine the way instruction is carried out, the way technology is used, and involvement by teachers in the decision making about technology use in the classroom. Future work should also look at gradations of objectivist and constructivist beliefs in teachers from kindergarten to sixth grade to detect any patterns from early to later grades. Such a pattern would have a major effect on the way teachers are trained and the way instruction is viewed over the course of elementary school. In addition, studies should identify other variables, such as professional engagement, that relate to beliefs and practices.

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Nicole J. Kurz-McDowell teaches in Henrico County in Richmond, Virginia. She earned her MAEd in elementary education from The College of William and Mary.

*Nicole J. Kurz-McDowell
Jacob L. Adams Elementary
600 South Laburnum Avenue
Richmond, VA 23223
kurznj@aol.com*

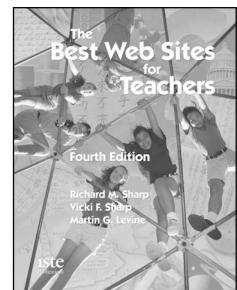
Robert D. Hannafin is an associate professor at The College of William and Mary, where he teaches educational technology in the preservice program.

*Robert D. Hannafin
College of William and Mary
PO Box 8795
Williamsburg, VA 23187-8795
757 221 1713
rdhann@wm.edu*



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