Teacher Planning Problem Space Of Expert Technology Integrating Teachers

Erin Davis
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| **Atlanta Public Schools**                                    |             |
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International Society for Technology in Education (ISTE)
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ABSTRACT

TEACHER PLANNING PROBLEM SPACE 
OF EXPERT TECHNOLOGY 
INTEGRATING TEACHERS 
by 
Erin Leslie Davis

Although expert technology integrating teachers exist, designing meaningful technology integrated learning remains a challenge. To address this problem, the purpose of this single case study was to examine how experts plan for technology integration. The conceptual framework of this study drew from information processing theory and combined two existing constructs: the notion of a problem space (Simon & Newell, 1971) with a process model of teacher planning (Yinger, 1980). The resulting combination was a new construct called the teacher planning problem space. The significance of this study was in the application of this new construct to focus on thoughts, decisions, and judgments of teachers during the planning process for technology integration rather than a focus on the act of teaching a lesson. Participants included a purposeful sample of six technology-integrating experts designated as such by their distinction as the winners of an innovation award sponsored by the Public Broadcasting Service and The Henry Ford. Winning the award bounded the case and the unit of analysis was how each teacher negotiated the teacher planning problem space. Data collection included a survey, interviews, audiovisual materials, and documents. Qualitative content analysis methods were used for interpreting the data, with these interpretations presented as a single case. The results indicated expert technology-integrating teachers continuously sought to improve instruction for their students and technology served to facilitate this goal. Learning from experience including mistakes as
well as knowledge of technology’s affordances were the major contributors to these teachers’ flexibility, troubleshooting, and fearlessness when implementing innovative practices with technology. The teacher planning problem space model resulting from this study provides theoretical implications for examining teacher planning. Practical implications include suggestions for administrative policies regarding lesson plan requirements and planning strategies for integrate technology.
TEACHER PLANNING PROBLEM SPACE
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Erin Leslie Davis

A Dissertation

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CHAPTER 1

THE PROBLEM

How teachers use instructional technology has the potential to change the quality of teaching and learning, but too often teachers’ efforts to create change have resulted in the isolation of technological practices rather than incorporation of them into teaching and learning (Earle, 2002); hence the “islands of innovation” phenomenon in which innovative pedagogical practices were found among 15% or less of the teacher population at a particular school (Forkhosh-Baruch, Mioduser, Nachmias, & Tubin, 2005; Tubin, Mioduser, Nachmias, & Forkosh-Baruch, 2003). For the purposes of this study, innovation refers to technology-supported innovation and is referred to as pedagogical solutions supporting a shift from traditional educational paradigms (teacher-centered) toward emergent ones based on fostering learner-centered processes (Forkhosh-Baruch et al., 2005; Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2003; Pelgrum, Brummelhuis, Collis, Plomp, & Janssen, 1997).

Educators who use technology to implement more learner-centered processes rather than traditional paradigms are innovators: teachers who view growth and change as an integral part of their profession and are willing to swim against the tide of conventional operating procedures (Dede, 1998). In 2010, Public Broadcasting System (PBS) and The Henry Ford created the Teacher Innovator Award (TIA) to recognize these innovators who use digital media to enhance student learning as classroom teachers, media specialists, technology coordinators, and homeschool educators (PBSLearningMedia, 2013). These award winners are examples of expert teachers who are leading the charge of educational change in technology integration. As Fullan (1982)
proclaimed, “Educational change depends on what teachers do and think—it’s as simple and complex as that. …If educational change is to happen, it will require that teachers understand themselves and be understood by others” (p. 107).

Technology “in and of itself does little to drive fundamental improvements in teaching and learning” (Culp, Honey, & Mandinach, 2005, p. 22). According to Earle (2002), technology integration is not about technology. It is about instructional practices; using technology tools to deliver content and implement pedagogical practices in better ways (Earle, 2002). Technology integration requires:

- an understanding of the representation of concepts using technologies;
- pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face;
- knowledge of students’ prior knowledge and theories of epistemology; and
- knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (Koehler & Mishra, 2009, p. 66).

Cuban (2003) suggested that without respect for the expertise that teachers bring to existing conditions in their classrooms, there is little hope of integrating technology into teaching and learning. Expert teachers behave differently than their novice counterparts (Berliner, 1988; Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987). Expert teachers often possess the following characteristics:

- automaticity and routinization (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986; Sternberg & Horvath, 1995);
- flexibility in teaching (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986);
- quick and accurate judgment, and meaningful pattern recognition (e.g.
Berliner, 2001a; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987; Sternberg & Horvath, 1995); and

• a specialized knowledge specific to the domain of expertise (e.g. Berliner, 2001a; Peterson & Comeaux, 1987; Shulman, 1987; Sternberg & Horvath, 1995).

These characteristics are evident in how an expert teacher prepares to teach a lesson as well as in how an expert actually implements the lesson. John (2006) believed that lesson planning was often created through a variety of processes that were “highly personal, idiosyncratic, and embedded in the subject and classroom context of the topic being planned (p. 489).”

Ertmer, Gopalakrishnan, & Ross (2001) defined expert technology-integrating teachers as those who use technology in learner-centered, constructivist environments characterized by what Becker & Riel (1999) identified as activities that were designed around interests, practiced in authentic contexts, and focused on understanding complex ideas. Affirming this notion of an expert technology-integrating teacher, Tubin et al. (2003) referred to these teachers as islands of innovation in a sea of traditional practices. The innovations were typically initiated and sustained by only a small group of leading figures that rose to face the challenge of implementing novel pedagogical solutions characterized as student-centered, process-oriented, and learning-by-doing.

Statement of the Problem

Although the Teacher Innovator Award recognizes a number of expert technology integrating teachers every year, designing meaningful technology integrated learning
remains a challenge for teachers. In a study by the National Center for Educational Statistics, over 3000 teachers were surveyed, and only 29% reported using computers during instructional time (Gray, Thomas, & Lewis, 2010). Gorder (2008) found that teachers used technology for professional productivity and to facilitate and deliver instruction rather than integrating it into teaching and learning. Other researchers affirm the disappointing levels of teacher’s technology integration (Cuban, 2006; Groff & Mouza, 2008; Wang & Reeves, 2004; Zhao, Pugh, Sheldon, & Byers, 2002).

One reason teachers struggle with technology integration is due to a lack of knowledge. Specifically, a lack of technology knowledge and technology-supported pedagogical knowledge have been identified as reasons why teachers do not integrate technology (Hew & Brush, 2007). Technology knowledge involves the skills needed to use a particular technology (Mishra & Koehler, 2006), whereas technology-supported pedagogical knowledge refers to an understanding of the affordances and constraints of particular technology in order to choose the best technology to represent or transform the content (Koehler & Mishra, 2009). To help outline the kinds of knowledge teachers need to successfully integrate technology, the International Society for Technology in Education (ISTE) has created standards for the knowledge educators need for teaching in a technology-rich environment. The standards that refer specifically to teacher knowledge, ask that teachers:

- Use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.
- Design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the student standards.
• Exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. (ISTE, 2012)

For educators, choosing the best technology to represent and transform content has been an issue for over 90 years beginning with the promise of modern machines such as the magic lantern and stereoscope but educators’ choices have resulted in very little change in classroom teaching practices (Earle, 2002). To address the challenges teachers face when integrating technology, this study attempted to shed light on the problem solving processes teachers encounter when designing meaningful technology integrated instruction.

**Statement of Purpose**

Expert teachers tend to spend more time than their novice counterparts in the initial stages of problem solving, taking longer to examine a problem, to build deeper and richer problem representations, and to think through strategies (Berliner, 1986, 2001b). Furthermore, experts solve problems faster than novices because they 1) recognize meaningful patterns, 2) are more flexible and change representations when appropriate, and 3) develop automaticity in their behavior to process more complex information (Berliner, 2001b). Thoughts, decisions, and judgments of expert teachers also provide opportunities to examine the role of technology integration knowledge and experience in the development of technology integration expertise.

Palmer, Stough, Burdenski, & Gonzales (2005) conducted a study to propose a set of guidelines for identifying expert teachers in future studies. They reviewed 27 studies that employed expert teachers as participants. From their results, Palmer et al. (2005)
recommended a two-phase process for identification. The first phase was a screening process for experience and knowledge and the second phase was based on performance. The most important performance indicator was receiving recognition as an exemplary teacher by multiple constituencies, based on indicators of teacher effectiveness to include teacher knowledge and skills, and confirmed by documented evidence of teacher impact on student performance (Palmer et al., 2005).

As previously mentioned, TIA winners are examples of expert technology-integrating teachers. Although it is not possible to determine the experience and knowledge of the TIA winners from their entries posted on the PBS Teachers Innovation Awards Gallery, the presence of Palmer et al.’s (2005) selection criteria were evident. To win the innovator award, teachers were required to submit a three-minute video clip or three-page PDF file that provided evidence of innovative practices with students or an innovative project that was the result of an instructional activity (PBSLearningMedia, 2012). A panel made up of PBS online professional development facilitators, The Henry Ford educational advisors, and other representatives from educational organizations selected the TIA winners. The entries were judged on originality/creativity, application or reinforcement of 21st century learning skills, effective integration of digital media, student engagement, and student learning. In addition to the award, winners received an approximately $2000 worth of prizes including airfare, lodging, meals and a week-long Innovation Immersion Experience at The Henry Ford in Dearborn, Michigan (PBSLearningMedia, 2012).

Recognizing the TIA recipients as expert teachers, the purpose of this study was to describe the planning strategies these expert teachers used in designing technology-
Research Objectives

The objective of this study was to describe the planning strategies that expert teachers, identified as TIA recipients, used in designing technology-integrated instruction. The over-arching research question associated with this objective was: How do expert teachers plan for technology-integrated instruction? The sub-questions were:

1. How do expert teachers negotiate the planning task environment?
2. How do expert teachers negotiate the planning problem space?

Conceptual Framework

Teaching with technology has been referred to as a complex, unpredictable, and ill-structured problem to solve wherein the role of the teacher is that of a problem-solving expert (Koehler & Mishra, 2009; Mishra & Koehler, 2006). Calderhead (1984) agreed with the role of the teacher as problem solver and viewed the planning to be appropriately conceptualized as a problem-solving process. He also described planning as a place where “teachers translate syllabus guidelines, institutional expectations, and their own beliefs and ideologies of education into guides for action in the classroom. This aspect of teaching provides the structure and purpose for what teachers and pupils do in the classroom” (p. 69). From the perspective that teaching with technology is an ill-structured problem, the act of planning for instruction serves as a strategy for solving this ill-structured problem. The conceptual framework of this study draws from information processing theory and combines two existing constructs: the notion of a problem space.
(Simon & Newell, 1971) with a process model of teacher planning (Yinger, 1980). I also used the construct of schemas to help define the broad conception of knowledge.

**The Problem Space**

According to Tsui (2003), studies of expertise in teaching mainly take the form of novice-expert comparisons drawing on teachers’ mental processes in planning and decision-making. These mental processes are seen as a link between thought and action, and are heavily influenced by information processing theory cognitive psychology (Tsui, 2003).

Adapted to planning for technology integration, the overarching structure for the conceptual framework of this study was Newell & Simon’s (1972) a problem space (see Figure 1). A problem space is part of a larger theory of human problem solving. Rooted in computer simulation, Newell, Shaw, & Simon (1958) demystified what was thought to be an inaccessible cognitive activity by proposing the theory of human problem solving which gave rise to the first information processing model (Voss, 2005). The theory references an information processing system in which the problem solver is confronted with a task and defines a problem space for the purposes of solving the task (Simon & Newell, 1971).

![Figure 1. Model of a problem space (Newell & Simon, 1972). According to Newell & Simon (1972), a problem space has three elements: a problem state, a search space, and a goal state. The search space contains operators or strategies that may be used to solve the problem.](image)
A task “is defined objectively (or from the viewpoint of an experimenter, if you prefer) in terms of a task environment,” (p. 148) which is outside the control of the problem solver. Problem solvers perceive the task environment as a problem to solve. They take that objectively defined task and create their own personal definition “for purposes of attacking it, in terms of a problem space” (p. 148). It is important to distinguish “between the task environment—the omniscient observer’s way of describing the actual problem ‘out there’—and the problem space—the way a particular subject represents the task in order to work on it” (p. 151). The problem space is constructed in the problem solver’s mind and represents the space to search for possible situations that correspond to the solution, or the search space (Simon & Newell, 1971).

A common example of a problem used in problem solving research is a puzzle called the Tower of Hanoi (Chi, 2011). The solve the puzzle, three disks of different sizes need to be moved from the first peg to the last peg, but only one disk can be moved at a time and a smaller disk must be on top of a larger disk (Chi, 2011). Simon & Newell (1971) used the Tower of Hanoi puzzle as an example of a problem with a relatively small problem space (see Figure 2). Level 1 represents a task environment along with the rules of the puzzle. Between Level 1 and Level 2, the solver creates a problem space and determines the problem state. Levels 2 – 8 represent the search space that a problem solver creates to solve a problem, or where the solver determines which path to follow to find a solution for the problem. The dotted lines represent different paths the solver can take to arrive at the solution, or goal state, denoted by the rectangular box in the bottom right corner of the figure.
Figure 2. Example of a problem space: the Tower of Hanoi puzzle. The dotted lines represent the paths to solve the puzzle.

A problem solver is presented with the puzzle and the aforementioned rules to solve the puzzle: the task environment. When the problem solver begins to solve the puzzle, there are several paths to arrive at the solution, or goal state. An individual problem solver’s path is the problem space. Admittedly, the Tower of Hanoi puzzle is a well-structured problem in which there is one correct answer, the constraints are known, and the path to the solution is both evident and logic-based (Kitchner, 1983; Voss, 2005). Applying the concept of a problem space to an ill-structured problem is much more complicated.

An ill-structured problem has multiple solutions, unclear constraints, several paths to a solution, and often requires personal opinions, beliefs, and judgments (Jonassen, 1997; Kitchner, 1983; Voss, 2005). Teaching with technology is an ill-structured problem for which planning is part of the problem solving process (Calderhead, 1984; Koehler & Mishra, 2009; Mishra & Koehler, 2006). For this study, Simon & Newell’s (1971) notion
of a problem space was adapted to explore teacher planning. Similar to the problem space created for solving the Tower of Hanoi puzzle, the solver or the teacher was presented with both the problem and a set of rules. The problem presented to the teacher was to solve the instructional problem of how best to teach the curriculum to students. The rules or conditions the teacher faces were external factors that are for the most part out of the teacher’s control. Yinger (1980) identified these factors as the teaching environment, school organization, the curriculum, resources, and student characteristics, which I have identified as the planning task environment, to be described in detail in a subsequent section. The planning task environment was made up of both the curriculum and a cluster of external factors.

Planning Task Environment

As previously mentioned, according to Simon & Newell (1971), a task environment contains two objectively presented elements: the actual problem and the problem constraints. In the planning task environment, the actual problem is the teaching the curriculum and the problem constraints are viewed as an external cluster of factors or conditions (see Figure 3).

Figure 3. Adaptation of task environment to teacher planning. The red text represents the adapted part of Simon & Newell’s (1971) problem space to the concept of teacher planning. The planning task environment consists of a cluster of external factors that can influence planning. Images, © 2014 Common Craft®.
Standards are often determined at a national or state level, and then local districts make decisions on sequencing of content. The current national standards require that students use technology strategically to write, solve problems, interact, and collaborate with the guidance and support of teachers (CCSSO & NGACenter, 2012), thus necessitating planning for technology integration.

External elements or conditions that can influence how the curriculum is taught include the school environment, the teaching environment, and resources. Within the school environment, factors such as school schedules, course loads, administrative policies and procedures, and common planning times contribute to when planning occurs and if teachers are required to turn in lesson plans. For the purposes of this study, the teaching environment refers to what occurs in a classroom. This physical classroom can place limitations on activities a teacher plans because of its size and shape. The number of students and characteristics of the students in a class may limit the amount of attention the teacher can provide for each student as well as the activities that are feasible.

Additionally, within a particular class, a teacher must account for a wide range of student characteristics adding to the complex environment of teaching including but not limited to abilities ranging from high to low, behaviors ranging from on task to oppositional defiant, and learning disorders that manifest in many different ways.

Lastly, resources, or lack thereof, have an enormous impact on planning, especially for technology integration. The ratio of one computer to one student provides the teacher with different planning options than the ratio of one computer to an entire class. The availability of the Internet also provides affordances and constraints on planning processes in terms of locating resources as well as creating activities using the
Internet. Individual characteristics that students bring to the classroom and the dynamics that exist once they come together in a class are outside of the teachers’ control but can influence how the teacher plans activities. These influences are dynamic and change as planning proceeds from general levels such as unit planning to more specific daily lesson plans (Yinger, 1980).

**Planning Problem Space**

Because much of expert teachers’ planning is not written down (John, 2006), planning remains an internal process only to be revealed during the act of teaching. The internal processes included in the *problem space* provide an overarching structure with which to examine the mental “space” where teachers do most of their planning. The *planning problem space* uses the original elements of Simon & Newell (1971) *problem space*: *problem statement*, *search space*, and *goal state*. In the *problem space* adapted for planning, teachers create a *planning problem space* when they interpret the use of factors from the *planning task environment* for their own instruction. The curriculum helps a teacher determine the guiding principles for what to teach. This interpretation serves as the *problem statement*, which is highly individualistic to a teacher’s particular class. Planning actually occurs in the *search space* to arrive at the *goal state*, or the point at which a lesson ready is for students (see *Figure 4*).
To better understand the complexities of a problem space specific to the context of planning, I used Yinger’s (1980) process model of teacher planning (see Figure 5) in combination with Simon & Newell’s (1971) problem space. The notion of problem space is not traditionally applied to teacher planning. The combination of problem space and Yinger’s (1980) process model is unique to this study and adds to its significance in research on teacher planning.

Figure 4. Adaptation of problem space to teacher planning. The red text represents the adaption of Simon & Newell’s (1971) problem space to problem-solving process of teacher planning. Images, © 2014 Common Craft®.

Figure 5. The process model of teacher planning. The model represents three stages of planning (Yinger, 1980).
Some of the richest forms of teachers' planning occur as complex mental dialogue and reflective thinking; therefore, this never appears in writing (McCutcheon, 1980). Because of this, there is a need for a more detailed structure for examining the mental space. In 1980, Yinger proposed a process model of teacher planning focused on the “deliberate information-processing involved in planning, from an initial idea to its execution in the classroom (p. 113).” This model deviated from traditional models of planning (e.g. Popham & Baker, 1970; Taba & Spalding, 1962; Tyler, 1949) that recommended that teachers specify objectives, select activities, organize activities, and identify evaluation procedures in that order. Additionally, Yinger (1980) viewed planning as a problem-solving endeavor.

The three-stage process model of teacher planning emphasized discovery and design rather than processes of choice (Yinger, 1980). Stage 1, or the problem-finding stage, was the first step in planning, during which “the general planning task is translated into a specific planning problem” (p. 114). Referred to as design cycle process, Stage 2 involved an elaboration of the initial conception of the problem which was then mentally tested until a solution was found (Yinger, 1980). The third stage was the implementation of a lesson.

Stage 1 and Stage 2 of Yinger’s (1980) process model are relevant to this study and Stage 3 is excluded, because the first two stages are directly related to planning strategies rather than the implementation of a lesson. To understand more about how teachers plan, I felt it was necessary to situate these first two stages of Yinger’s (1980) process model within a problem space for planning. Stage 1 of Yinger’s (1980) model aligns with Newell & Simon’s (1972) problem statement element of a problem space.
Stage 2 of Yinger’s (1980) model also aligns with Newell & Simon’s (1972) concept of a search space. I renamed the resulting combination of Newell & Simon’s (1972) search space and Yinger’s (1980) Stage 2 to design space (see Figure 6).

**Design Space**

The design space is the mental space where teachers search for all possible ways to design a lesson using what Yinger (1980) called a “cyclical design process.” The phases of this design process are elaboration, investigation, and adaptation. Elaboration occurs in two ways: recombination of routines and creation of new elements not part of the teacher’s repertoire of experience. According to Yinger (1980), the elaboration phase resulted in a solution of a sub-problem or to the completion of some aspect of the total problem. However, he claimed solutions were tentative because their feasibility had not been tested. During the investigation phase of the problem formulation/solution stage, a teacher explores the workability of the tentative solution. Relying on knowledge and methods attained through experience in this phase, a planner thinks through mental
process by visualizing a solution and anticipating outcomes (Yinger, 1980). Adaption is a phase of integration and transformation in which the planner incorporates what occurred in both the elaboration and investigation phase (Yinger, 1980). The ways in which teachers move through this design cycle process is by applying their knowledge and experience, both mental activities that influence planning. For the purposes of this study, the representations of knowledge and experience were thought of in terms of schemas.

**Schemas**

There are many versions of schema theory, but for the purposes of this study, I used the notion of a schema as “a modifiable information structure that represents … knowledge that we experience,” which enables “people to construct interpretations, representations, and perceptions of situations (Glaser, 1985, p. 8).” A schema can be thought of as an internal model to instantiate situations: providing a source of representation and prediction (Glaser, 1985). Because the problem-solving process depends on knowledge, a schema can be used to better understand the components of the *problem space* (Jonassen, 1997). Schemas are one way of characterizing knowledge based on the premise that the essence of knowledge is structure (Anderson, 1984). Chi, Glaser, & Rees (1982) believed that knowledge structures in the form of schemas should be used to capture the problem-solving processes of experts. Researchers (e.g. Borko, Bellamy, Sanders, Russell, & Munby, 1992; Borko & Livingston, 1989; Clark & Peterson, 1986; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987) also believe that expert teachers have more elaborate, complex, interconnected, and easily accessible schemas. They differ, however, on how schemas are defined as well as the types of
schemas that apply to different aspects of planning. I preferred to view schemas as a broad conception of knowledge rather than a narrow one that defines a priori types of schemas and maps them to a particular characteristic of expertise. With respect to schemas, I view the knowledge structures for planning technology-integrated instruction as emergent and as such these knowledge structures develop from experiences with technology and for technology integration. For example, a successful experience with using a technology tool for students to turn in a homework assignment may become a routine that is employed for all homework assignments, whereas an unsuccessful experience due to particular constraints of a technology tool such as an unanticipated cost or difficulty of use may lead to the teacher disregarding the intended use not only of the tool but also of the entire process for which the tool served.

The ways in which a teacher learns to perceive problem situations and the knowledge and methods a teacher draws from memory create constraints related to knowledge and experience (Yinger, 1980). Both knowledge and experience provide the teacher with a repertoire of ideas and routines that influence the direction of the planning process (Yinger, 1980). Practice allows expert problem solvers to better categorize, proceduralize, and automatize a problem situation (Jonassen, 1997).

Schemas become more highly developed over many hours of learning and experience (Glaser, 1985; Jonassen, 1997). Although experience is considered a necessary condition for expertise, it is not a sufficient one (Palmer et al., 2005). Teachers can possess many years of experience and not demonstrate expertise. Experience contributes to an expert’s use of established routines, grouping strategies, subject matter content knowledge, and pedagogical strategies for representing subject matter content in
ways in which their non-expert counterparts do not. Using routines to facilitate relatively low-level activities, expert teachers can devote significant mental resources to more substantive activities (Leinhardt & Greeno, 1986). The use of routines not only increases efficiency, but also serves to expand the teacher’s ability to deal with unpredictable elements (Leinhardt & Greeno, 1986).

Additionally, both insufficient knowledge of, and lack of experience with technology can constrain plans for the use of technology. Expert technology integrators possess *technology-supported pedagogical knowledge* — an understanding of the affordances and constraints of particular technology in order to choose the best technology to represent or transform the content (Koehler & Mishra, 2009). As expert teachers plan technology-integrated instruction, they are faced with design constraints bound by context, knowledge, and experience. Contextual constraints surface in the form of contingency plans based on ambiguous information. Knowledge and experience constraints arise with respect to *technology knowledge* as well as *technology-supported pedagogical knowledge*.

**The Model**

Yinger (1980) did not reference Simon & Newell’s (1971) notion of *problem space* in his planning model; however, the two constructs in combination provide an excellent lens for studying teacher planning as a problem-solving endeavor. I adapted Yinger’s (1980) model and situated it within Simon & Newell’s (1971) concept of a *problem space*. I renamed *problem space* to *planning problem space* to reflect the problem-solving processes related to aspects of teacher planning. Because instructional problem solving includes some external factors, I felt it necessary to also include Simon
& Newell’s (1971) concept of a *task environment*, but renamed it to the *planning task environment*. I designated the resulting combination as the *teacher planning problem space*.

From the perspective that a teacher is a problem solver and teaching with technology is an ill-structured problem, the conceptual framework for this study was that planning for technology integration takes place in a *teacher planning problem space*. The notion of *problem space* was borrowed from information processing theory, which involves both external and internal influences on the problem solving process. To contextualize the *problem space* in instructional planning, I drew from Yinger’s (1980) *process model for teacher planning* but only considered the first two stages that were applicable to the planning process. The third stage of the model was related to the implementation of instructional plans and was therefore outside the scope of this study. The application of Yinger’s (1980) *process model for teacher planning* to the construct of a *problem space* is unique and to my knowledge is found nowhere in literature on teacher planning. My model served as the conceptual framework for this study (see *Figure 7*).

To understand the mental models that teachers create during the planning process, I characterized knowledge in terms of schemas; however, I departed from the information-processing conception of schemas for a more constructivist perspective in which teachers generate schemas relative to planning specifically for technology integration. The nature of these schemas cannot be predetermined but emerged as part of the data analysis process. In this study, schemas were used to represent the thoughts, decisions, and judgments teachers make in the *teacher planning problem space* while planning for technology integration (see *Figure 7*).
Figure 7. The teacher planning problem space. This model is a combination of Simon & Newell’s (1971) notion a problem space and Stage 1 and Stage 2 of Yinger’s (1980) process model for teacher planning. The combination of a search space and Stage 2 was renamed to design space. Images, © 2014 Common Craft®.

Significance

The teacher is the one of the most important elements in teaching and learning and has an major impact on the successful integration of technology (Chen, 2008; "U.S. Congress. OTA EHR 616," 1995; Wang & Reeves, 2004). Enhancing teachers’ technology integrating expertise therefore is important to increasing the likelihood that others will integrate technology. One significance of this study is that it added to the to already existing body of research on the complex nature of teacher expertise and contribution that experts made to assist non-experts.

Another significance is that study was unique in terms of the conceptual framework as well as in the focus on the planning process that occurred before the performance of teaching. Bitner and Bitner (2002) claimed that teachers need to conceptualize how the use of technology will facilitate teaching and learning. By examining how expert technology-integrating teachers planned for technology-integrated instruction in a conceptual space, this study provided examples for non-experts.
Additionally, teachers need “opportunities to observe models of integrated technology use, to reflect on and discuss their evolving ideas with mentors and peers, and to collaborate with others on meaningful projects as they try out their new ideas about teaching and learning with technology (Ertmer, 1999, p. 54).” A third significance is that this study revealed factors that were related to technology-integrating experts’ thoughts, decision-making, and judgments as they planned for instruction.

**Study Limitations**

Because the research objectives of this study dealt with the planning process for technology integration in the classroom, a case study methodology was chosen for this research. Common in case study research, the number of participants in this study was small. The purposeful sampling method used to obtain the six participants decreased the generalizability of this study’s outcomes; however, a thick rich description was used to describe the complexities associated with expertise and technology integration (Howard, Lothen-Line, & Boekeloo, 2004). Another limitation was the definition of expert and identification of experts. There is no shared definition of expert, and the identification of an expert continues to be troublesome for researchers, practitioners, and policymakers (Berliner, 1986; Borko et al., 1992; Ertmer et al., 2001). The participants chosen for this study were considered experts because they had been recognized for their technology innovation in the classroom by a national award. Recipients of the award were judged by a panel rather than by peer nomination. A third limitation of the study was in pre-determining the definition of technology integration. According to Ertmer et al. (2001), defining technology integration from the literature created a definition that tended to...
deviate from the language and actual practices of teachers who identify themselves as exemplary users.

**Study Delimitations**

It was as important to define what will be studied as what will not be studied (Miles & Huberman, 1994; Stake, 1978). Because the TIA award winners were from several different schools across the United States, it was not feasible to conduct observations of actual teaching situations. Therefore, the actual implementation of a lesson was outside the scope of this study; however, that does not mean that the connection between planning and implementation was excluded. The planning process could not be separated from the implementation of those plans because the results of teaching a lesson added to a teacher’s repertoire of knowledge and experience, which became an important part of subsequent planning (Yinger, 1979). Although the analytical framework did not reference the implementation of a lesson, it did acknowledge the contribution of knowledge and experience gained through teaching to expertise such as routinization, flexibility, and quick and accurate judgment (Berliner, 2001a; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987; Sternberg & Horvath, 1995). Hence, the implementation of a lesson was not observed but was considered as it related to planning through teacher reflections upon the lesson.

**Definition of Terms**

*Affordances and constraints of technologies* refers to “the strengths and weaknesses of technologies with respect to the possibilities they offer the people that
might use them (Gaver, 1991, p. 79).”

*Common Core State Standards (CCSS)* refers to a set of expectations for the knowledge and skills students should learn in English language arts and mathematics at each grade level with the goals of providing a relevant real world connection and reflecting what students need to be successful in college and other career paths (CCSSO & NGACenter, 2012).

*Constructivist environments* refers to a collaborative, authentic, learner-centered environment in which students focus on complex ideas and evaluate their own understanding (Becker & Riel, 1999).

*Curriculum* refers to course content derived from a given set of standards adopted by a school district or individual school within a district (e.g. International Baccalaureate curriculum).

*Expert technology-integrating teacher* refers to teachers who use technology in learner-centered, constructivist environments (see Constructivist environment) (Ertmer et al., 2001).

*Human problem solving theory* refers to characteristics of the human information-processing system which are sufficient to determine that problem solving takes place in a *problem space*; the task environment determines the possible structures of the *problem space*; and the structure of the *problem space* determines the possible programs that can be used for problem solving (Simon & Newell, 1971, pp. 148-149).

*Ill-structured problem* refers to a problem that is multifaceted, vague in its definition, possesses multiple solutions, lacks rules or procedures, contextually bound, and requires personal judgment (Jonassen, 1997).
*Islands of innovation* refers the existence of innovative pedagogical practices in 15% or less of the teacher population at a particular school (Forkosh-Baruch et al., 2005).

*Pedagogical practices* refer to techniques or methods used in the classroom related to “understanding how students learn, general classroom management skills, lesson planning, and student assessment (Koehler & Mishra, 2009, p. 64).

*Problem space* referred to the “fundamental organizational unit of all human goal-oriented symbolic activity” (Newell, 1979, p. 4) and include both internal and external factors.

*Planning problem space* referred to the adaptation of Simon & Newell’s (1971) notion of a *problem space* but relates specifically to planning as the problem-solving processes teachers create as they plan for technology-integrated instruction.

*Planning task environment* refers to the adaptation of Simon & Newell’s (1971) notion of a *task environment* but relates specifically to planning as a given set of conditions (e.g. National standards or school schedules) outside the teachers’ control associated with performing a task (Simon & Newell, 1971).

*Routines* refers to sequential segments of socially scripted behavior such as such as checking homework, presenting content, guiding practice, and conducting discussions (Borko & Livingston, 1989; Leinhardt & Greeno, 1986).

*Schema* refers to “a modifiable information structure that represents … knowledge that we experience” and enables “people to construct interpretations, representations, and perceptions of situations (Glaser, 1985, p. 8).”

*Schema theory* refers to the idea that people possess categorical rules or scripts to
interpret the world and new information is processed according to how it fits into these rules (Widmayer, 2005). Cognitive psychologists use schema to describe the way knowledge, or information structures are stored in memory (Tsui, 2003).

*Task environment* refers to the given set of conditions or objectively defined information outside the problem-solvers’ control associated with performing a task (Simon & Newell, 1971).

*Teacher planning problem space* refers to the application of Yinger’s (1980) *process model for teacher planning* to the construct of a *problem space* and serves as a conceptual framework for this study.

*Technology integration* refers to “an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students’ prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (Koehler & Mishra, 2009, p. 66).”

*Well-structured problem* refers to one in which there is one correct answer, the constraints are known, and the path to the solution is both evident and logic-based (Kitchner, 1983; Voss, 2005).

**Summary**

The chapter provided an overview of the study to investigate the planning processes of expert technology-integrating teachers. Although islands of expert
technology integration planners exist, designing meaningful technology integrated learning remains a challenge for teachers. To address this problem it was important to examine how experts planned for technology integration to assist non-experts in their endeavor to integrate technology. Hence the guiding question for this study was to describe planning strategies of expert technology integrating teachers. To address this question, I investigated how expert technology-integrating teachers’ planned for instruction and what factors influenced their planning experience. The significance in studying experts’ planning processes was that these processes provided models for non-experts regarding the perspectives and processes of experts.
CHAPTER 2

REVIEW OF THE LITERATURE

The main research objective of this study was to explore expert teachers’ lesson-planning strategies for technology-integrated instruction. From the perspective of teaching as an ill-structured problem to be solved through planning, the following discussion is a review of the related literature connecting expertise in planning for technology integration to specifically address the research objective: How do expert teachers plan for technology-integrated instruction? The sub-questions were:

1. How do expert teachers negotiate the *planning task environment*?
2. How do expert teachers negotiate the *planning problem space*?

This chapter is organized into four sections: Problem Solving, Teacher Planning, Expertise in Teaching, and Expertise in Technology Integration. The first section, Problem Solving provides literature related to teachers as problems solvers and how they use problem-solving strategies to solve instructional problems. The second section, Teacher Planning, provides examples of literature before teachers were expected to integrate technology into their lessons. Building on the teacher first as a problem solver and then planning as a problem-solving endeavor, the third section, Expertise in Teaching, addresses the expert characteristics of problem-solving teachers through the literature. The fourth section, Expertise in Technology Integration is the culminating section of the chapter and includes the literature related to expert problem-solving teachers’ use of technology in instruction. This fourth section specifically presents literature related to conditions that contribute to successful technology integration, exemplary technology
integrating teachers, developing technology integration, and planning for technology integration.

**Problem Solving**

The perspective of teaching as a problem-solving endeavor is not a new one. Bruner (1973), drawing on T.D. Weldon’s views of the world, likened education to the following:

There are troubles which we do not know quite how to handle; then there are puzzles with clear conditions and unique solutions, marvelously elegant; and then there are problems – and these we invent by finding an appropriate puzzle form to impose upon a trouble (Bruner, 1973, p. 104).

In this world, the teacher was responsible for finding the most appropriate “puzzle” to teach the content, or “trouble,” to solve an instructional problem.

Shulman and Elstein (Shulman & Elstein, 1975) compared the role of a teacher to that of a physician: an active information processor involved in planning, anticipating, judging, diagnosing, prescribing, and problem solving. Yinger (1980) suggested that the description of a teacher as a problem solver and decision maker was most appropriate during the planning phase of teaching rather than in the implementation phase because of the immediacy of teachers’ interactions with students often impeded rational, purposeful thinking normally associated with problem solving. More recently, Koehler & Mishra (2009) and Mishra & Koehler (2006) described the role of the teacher as that of a problem-solving expert for solving the complex, unpredictable, and ill-structured problem of teaching with technology.
The following sections discuss the literature related to problem solving in instruction. The discussion is organized by describing the predominant method for studying problem solving, the ways in which solutions are generated, and schema for problem solving.

**The Think-Aloud Model**

In their research on thinking, judgment, and decision-making, Shulman and Elstein (1975) reviewed theoretical models and research methods outside the field of education to extended them to investigate educational problems, focusing on the contexts in which teachers must cope with complex, uncertain, and imperfect information. One such approach reviewed was de Groot’s (1965) use of process-tracing methods to study the thought process of chess players. To collect the conversations of chess players’ deliberations, de Groot’s (1965) asked his participants to think-aloud as they deliberated different moves as they played. Shulman and Elstein (1975) suggested that think-aloud protocols be used in education to determine important decisions during instruction.

Several researchers (e.g. Archambault & Crippen, 2009; Borko & Niles, 1982; Calderhead, 1987; Ericsson & Simon, 1998; Livingston & Borko, 1990; Peterson & Comeaux, 1990; Peterson, Marx, & Clark, 1978; Sardo Brown, 1993; Shavelson, Ruiz-Primo, & Wiley, 2005) also described how to use or their use of think-aloud protocols to capture thinking processes.

One fundamental assumption associated with using think-aloud models was that teachers have some degree of access to their thinking that can be reported in words to describe how they learn to teach, translate curricular ideas into practice, and identify solutions to classroom problems. Different methods also made particular assumptions
about the nature of teachers’ knowledge drawing from a range of theories from psychology, sociology, and anthropology. These methods and assumptions created limitations. Referencing his own research on teachers’ thought processes, Calderhead (1987) described limitations of the use of verbal report procedures.

Stimulated recall is a strategy during which teachers are asked to recall what was going through their minds at a particular time. One limitation created in using the stimulated recall strategy was that teachers construct memories rather than report thoughts. Calderhead (1987) suggested that, in his research, a high proportion of teachers’ comments did not represent actual thinking and much of their commentary was irrelevant. He indicated that teachers developed a style of reporting that translates their actual thoughts into a narrative of memories that made sense about their behaviors rather than being a collection of seemingly disconnected thoughts.

Another limitation was that the complexity of teachers’ think-aloud reports did not fit neatly into established theories or methods; hence their reports were interpreted incorrectly or misidentified. For example a student teacher reported the use of circulation in the classroom to monitor behavior, which on the surface appeared to demonstrate a pedagogical skill. Upon further probing during an interview, however, the student teacher used the strategy not because she saw value in it or understood the pedagogy associated with it, but because it was expected of her. Calderhead (1987) recommended that researchers pay attention to the implicit and explicit assumptions inherent in theories and methods.

Using think-aloud methods detailed in varying degrees, researchers (Livingston & Borko, 1990; Peterson et al., 1978; Sardo Brown, 1993) studied teacher planning.
Livingston and Borko (1990) and Sardo Brown (1993) used semi-structured interviews to understand the participants’ own descriptions of planning processes but did not provide much detail as to their method. Peterson et al. (1978), however, investigated differences in teacher planning and the relationship of teacher planning to teacher behavior and student achievement and provided more information. Participants included twelve experienced social studies teachers who were asked to teach a lesson to three groups of middle school students. Teachers were asked to restrict their planning to the 90-minute planning sessions monitored by the researchers, during which the teachers were provided with content materials and asked to think-aloud as they planned. The participants listened to a model think-aloud recording to introduce the procedure and were then asked to talk into a recording device to record their thinking as they planned. Peterson et al. (1978) concluded that although their study was designed to confine planning to particular time, some participants might have planned outside of the scheduled time or did not articulate their planning aloud; hence acknowledging major limitations of the think-aloud process.

Another use of the think-aloud method is evident in Archambault & Crippen’s (2009) development of a survey to measure knowledge levels of technology, pedagogy, and content knowledge, otherwise known as a framework called TPACK. Within the TPACK framework, seven subscales exist: technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK). To establish construct validity, Archambault & Crippen (2009) conducted a two-phase think-aloud pilot study with six
participants. During the first phase of the pilot study, one of the researchers interviewed three of the six teachers and asked them to explain their responses to the survey questions. The purpose of the first phase was to ensure the survey questions were understood in the same manner and solicit suggestions for changes to the survey from the participants.

After making the suggested changes to the survey, the purpose of the second phase of the think-aloud pilot study was focused on consistent interpretation of survey items and the seven subscales associated with the TPACK framework. To do this, Archambault & Crippen (2009) met with three teachers who did not participate in the first phase of the pilot study. These participants were given descriptions of the subscale items and asked to read each survey item aloud and determine which subscale fit the item. One major difference noted during this think-aloud process was that the researchers had clear distinctions between content and pedagogy, whereas their participants linked them together as one domain. Archambault & Crippen (2009) recommended that anyone using their survey instrument should consider participants’ understanding of content and pedagogy when interpreting results.

Archambault & Crippen (2009) then tested their survey on a purposeful sample of 569 teachers who taught at least one online class in state-sanctioned K – 12 virtual schools across the United State. The researchers acknowledged the limitations of both self-reported data as well as their methods for construct validation, but did not provide details regarding a connection between their methods, specifically the think-aloud pilot study and conclusions. They did, however, admit that their model remained to be validated and that “perhaps there is a different structure to describe the domains of technology, pedagogy, content, and their possible interactions” (p. 14). The results of
Archambault & Crippen’s (2009) study revealed that teachers felt strongly about their ability regarding content and pedagogy but were more hesitant when it came to technology, which may have a direct connection to the understandings of teachers who performed the think-aloud. The researchers attribute this hesitancy in general terms to a lack of technology in activities that traditional teachers do, such as lesson planning, using teaching strategies to convey content, and assessment.

Models for Solving Ill-Structured Problems and Designing Instruction

Jonassen (1997) presented models for both how learners solve ill-structured problems as well as models for designing instruction to support problem-solving skills. He outlined a seven-step process for solving ill-structured problems:

1. Articulate the problem space and contextual constraints.
2. Identify and clarify alternative opinions, positions, and perspectives of stakeholders.
4. Assess viability of solutions by constructing arguments and articulating personal beliefs.
5. Monitor the problem space and solution options.
6. Implement and monitor the solution.
7. Adapt the solution.

These steps are similar to Newell and Simon’s (1972) human problem solving theory described in the conceptual framework for this study. Jonassen’s (1997) third step of generating possible solutions was important to understanding some of the strategies teachers used to problem solve.
Problem representation is an important strategy for generating solutions. According to Chi, Feltovich, & Glaser (1981) problem representation was a cognitive structure that corresponded to a particular problem, constructed by a solver based on knowledge and the organization of this knowledge, and the quality of a problem representation is not determined by knowledge itself but in the particular way the knowledge is organized (Chi et al., 1982). In their work on expertise in problem solving, Chi et al. (1982) explored relevant features of problem representation and found qualitative differences between experts and novices in areas such as solution speed, errors, and categorization and recognition of patterns. In addition to literal details of a problem, problem representation for experts also included inferences and abstractions derived from knowledge and experience (Chi et al., 1982). Jonassen (1997) adds that this process of generating solutions within a problem space is a creative process that includes unrelated thoughts and emotions.

Methods for Capturing Teacher Behaviors in Decision-Making

According to Jonassen (2012), decision making was the most common kind of problem solving and also involved the selection of one or more options from a larger set of options requiring a commitment to a course of action intended to yield satisfying results. In an example of a study conducted in a computer-simulated well-structured environment, Oisbiod, Ettinger, Abedi, and Shavelson (1989) examined decision making strategies for planning and teaching. Scenarios presented to teachers included information about a student’s gender, behavior, independence, social competence, self-image, and achievement. The teachers then chose a type of decision such as classroom management to address the student’s behavior in the scenario. The computer program captured how
teachers weighed information about students using the aforementioned variables and a set of decision options. Results of the study by Oisbiod et al. (1989) indicated that the model provided a way to determine the decisions that teachers felt were important, but the model was limited in that there was a finite selection of decisions from which to choose. Additionally, teaching did not occur in a well-structured environment in which the teacher could focus on one student at a time.

Decision-making in an ill-structured environment is much more difficult to capture. Making an instructional decision required many skills, some of which included formatively assessing student learning through multiple measures, anticipating student responses with an awareness of common misconceptions, and modifying instruction based on current student learning (Kohler, Henning, & Usma-Wilches, 2008; Superfine, 2009). Monitoring learning and decision making related to modifying instruction were difficult for pre-service teachers (Kohler et al., 2008), whereas inservice teachers relied on their previous experiences that provided an extensive and well-organized knowledge of both pedagogy and students (Superfine, 2009).

Two studies, one of pre-service teachers (Kohler et al., 2008) and one of inservice teachers (Superfine, 2009) demonstrated an attempt to portray decision-making in the ill-structured environment of teaching. Kohler et al. (2008) focused on making instructional decisions during and after the act of teaching, whereas Superfine (2009) emphasized planning and the implementation of those plans. To study pre-service teachers’ decision-making, Kohler et al. (2008) asked 150 student teachers to record and describe all instructional decisions using teacher work samples (TWS), a “performance-based assessment tool that enables teacher education programs to provide evidence of student
teachers’ ability to meet state and national teaching standards” (p. 2109). Faculty coordinators were responsible for introducing the student teachers to the TWS processes as well as for providing assistance, guidance, and feedback for completing it. One section of the TWS tool dealt with instructional decision-making directly, a prompt to “think of two times during your unit when a student’s learning or response caused you to modify your original design for instruction” (p. 2010). The directions for completing this section were to cite specific evidence to describe the event that caused the modification, the modification itself, and why this modification would improve student learning.

The results of coding 314 instructional decisions fell into three categories: initial formative assessment, modification, and follow-up assessment. Eight types of general modifications were evident in the student teacher TWSs: skills or objectives, methods of instruction, student tasks, student monitoring methods, student materials, types of feedback, student grouping, and student assessment. Although skeptical of teacher reflection by novice teachers, the results actually provided a rather comprehensive set of teacher behaviors for decision-making. What was lacking from this study, however, was information about the quality of the decisions made and the impact on student learning, most likely due to the form of the data collected which did not include interviews or observations. As expected, Kohler et al. (2008) found that student teachers provided more information for the initial assessment compared to the follow-up assessment; only 11% provided specific examples of student learning as a result of the follow-up assessment. Overall the results indicated that student teachers were most likely to alter instruction or modify student tasks to address difficulties with student comprehension.
Experience and routines influenced decision-making in the classroom (Leinhardt & Greeno, 1986; Livingston & Borko, 1990). Superfine (2009) examined the role of experience and the use of the teachers’ guide in the planning and implementation decisions of two experienced mathematics teachers and included interviews and observations as part of data collection methods. Superfine (2009) conducted an initial interview with participants to obtain information regarding teachers’ practices, made observations of teaching over the course of a unit, held pre- and post-observation interviews, and examined the teachers’ planning. As part of the data analysis, the participants were asked to read and respond to the written case created from their first interview. Superfine (2009) then used the interviews and observation analyses to further develop each case. No details were provided on the interviews and observation analyses.

The results of Superfine’s (2009) study established important relationships between teaching and curricular experience such as being able to anticipate aspects of the curriculum that were more difficult for students as well as the best way to represent the math curriculum to address this difficulty. One interesting point of discussion concerned the number of years needed to acquire teaching experience, typically achieved by the fifth year of teaching (Superfine, 2009). Although in the sixth year of teaching, one participant displayed characteristics of an inexperienced teacher, thus drawing attention to issues with attempts to easily determine experience in terms of years.

In problem solving, how knowledge is perceived is important to the study of teacher knowledge. According to some researchers (e.g. Borko & Livingston, 1989; Carter et al., 1987; Peterson & Comeaux, 1987; Shavelson & Stern, 1981), schema can be used to represent the knowledge or the thoughts, judgments, and decisions of teachers.
Shavelson (1986) divided teacher knowledge into script schemas, scene schemas, and propositional structures. *Script schemas* were classroom routines for checking homework, presenting new course content, or conducting a class discussion (Borko & Livingston, 1989). Script schemas tended to be sequential and related to saving time during instruction. *Scene schemas* were related to the teacher’s knowledge of the types of activities that should occur to promote learning such as whole group instruction or small learning groups (Borko & Livingston, 1989). *Propositional structures* represented what Shulman (1986) called pedagogical content knowledge, or “the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations—in a word, the ways of representing and formulating the subject that make it comprehensible to others” (p. 9).

Borko and Livingston’s (1989) a study investigated the thinking and actions of teachers using the concept of schema to explain the differences between novices and experts. Participants included four novice teachers and the expert teachers with whom they were placed. The results indicated that patterns of novice and expert teachers could be described in terms of script, scene, and propositional structures. The expert teachers’ lesson planning embodied all three structures, whereas the lesson planning of novice teachers demonstrated less developed schemas. The efficiency with which experts performed planning indicated that their schemas were more highly developed. Well-developed schemas also contributed to the expert teachers’ ability to attend to and process information that was relevant to following or modifying the lesson during the implementation of a lesson. Borko & Livingston (1989) also found that “improvisational teaching requires that the teacher have an extensive network of interconnected, easily
accessible schemata during teaching,” (p. 485) to select strategies, routines, and information bases on specific classroom occurrences.

In summary, teaching is both a complex cognitive skill and an improvisational performance (Borko & Livingston, 1989). The cognitive aspects of knowledge can be represented by schemas in the form of teachers’ representations of thoughts, decisions, and judgments. One method for eliciting these representations is through a think-aloud protocol. Examining planning practices can capture decision-making processes.

**Teacher Planning**

Instructional planning was considered one of the most important processes in teaching (Yinger, 1980). Investigating teachers’ planning provides a window on “how they transform and interpret knowledge, formulate intentions, and act from that knowledge and those intentions (Clark, 1988, p. 8).” In the literature, planning is typically defined as decisions the teacher makes prior to the act of teaching (Peterson et al., 1978; Sardo Brown, 1993). Yinger (1980) also situated planning within the context of all the activities teachers do before teaching. He viewed the teacher as a problem-solver and decision-maker during what Jackson (1965) coined as the preactive phase of teaching. Preactive teaching occurred whenever a teacher was in an empty classroom and encompassed many ways in which a teacher spent time including grading papers, setting up equipment, making copies, talking with colleagues, and planning. According to Yinger (1980), “Of the many things teachers do in the "empty classroom," planning is probably one of the most important (p. 108).” For this study, planning was defined as the instructional problems and decisions teachers make in the empty classroom.
Research about teacher planning typically falls into either descriptive or prescriptive approaches. Descriptive approaches paint a picture of how a teacher plans for instruction, or what Richardson (2009) described as from within the classroom walls as opposed to the outside-looking-in nature of prescriptive study. Researchers using a prescriptive approach looked to models to determine how teachers should plan.

Most research on teacher planning took place prior to the introduction of technology in the classroom (Richardson, 2009). Research on how teachers plan for the use of technology is therefore lacking and needs updating (Mccutcheon & Milner, 2002; Richardson, 2009; Tubin & Edri, 2004). The remainder of this section will address teacher planning literature without explicit mention of technology related to how teacher plan, how teachers should plan, factors that influence planning, and routines in planning.

**How Teachers Plan**

The predominant lesson planning model, although slightly modified throughout the years (e.g. Popham & Baker, 1970; Taba & Spalding, 1962), is based on Tyler’s (1949) sequential prescriptive model, the skeleton of which begins with the identification of objectives, learning activities, and the organization of learning activities, and ends with a lesson evaluation (John, 2006; Zahorik, 1975). The rational, logical model emphasized the ends (the objectives) over the means (the instructional activities) (Zahorik, 1975). John (2006) claimed that the main reasons for the popularity of a prescriptive model were that novice teachers needed to understand how to plan in a rational way before they could develop more complex lesson structures and juggle classroom variables, and that identifying a single format is easier to manage and assess.

MacDonald (1965) challenged the notion that specifying behavioral objectives for
teaching would create a rational decision making process from which to teach a lesson. He suggested that rather than specifying objectives, or identifying what a teacher was trying to accomplish, the teacher should focus on what they were going to do “and out of the doing comes accomplishment (p. 614).” He suggested that teachers’ first decisions focused on the type of learning activity and the objectives were revealed after students engaged in the activity (MacDonald, 1965).

Zahorik (1975), one of the first to study teacher planning, conducted a survey by examining planning models and planning decisions of 194 teachers to describe the kinds of plans they made prior to entering the classroom. Part I of the survey instrument requested that teachers write down their planning decisions in the order in which they made them. Part II requested that teachers provide examples of objectives and activities. Actual lesson plans were not included as part of the data collection because some teachers did not write down their decision in lesson plans and other teachers were required to use planning models that they did not support, resulting in pseudo plan that was ignored (Zahorik, 1975). Eight categories of planning decisions emerged from the results of Part I of the survey including decisions about:

- goals and lesson outcomes,
- subject matter to be taught,
- types of learning activities,
- resources,
- student readiness and prior learning,
- how to assess learning,
- teaching strategies, and
how to organize the teaching-learning environment (e.g. grouping, use of space, use of time).

The most frequent decision was related to student activities and was most often content related. Zahorik’s (1975) concluded that about one-fourth of the participants began their planning with objectives and that no one began planning by identifying learning activities. Additionally, teachers made decisions about the content for learning first, more frequently than any other of the eight categories of decisions. The results, however, were inconclusive as to which planning model (e.g. MacDonald, 1965; Tyler, 1949) teachers preferred.

Koeller and Thompson (1980) found similar results using Zahorik’s (1975) survey for their study. They asked a group of 56 elementary and middle school teachers who had at least three years of teaching experience how they prepared to teach. Participants, identified as outstanding teachers, were asked to write an ordered list of planning decisions as they prepared for a lesson, a class, a unit, or a course. More than half the respondents indicated that they did not begin lesson planning by specifying objectives. These teachers also did not consistently favor a particular planning model (e.g. MacDonald, 1965; Taba & Spalding, 1962; Tyler, 1949).

Peterson and Clark (1978) sought to discover individual differences in teacher planning and the relationship of teacher planning to teacher behavior and student achievement. The participants included 12 middle school social studies teachers who had 90 minutes to plan for one 50-minute lesson, that they would then teach to three different groups of students. The teachers were to use a think-aloud technique in which they were asked to talk into a recorder while planning lessons. The results revealed that the largest
proportion of statements made while planning focused on content followed by instructional process. The smallest number of planning statements was devoted to objectives. With respect to individual differences in teacher planning, the data indicated teacher planning seemed to be related to differences in teachers’ cognitive processing styles and abilities. After each lesson was taught, the Peterson & Clark (1978) measured student achievement to see if the participants’ teaching improved with repetition. The results were inconsistent. Four of the teachers were most effective during the second time of teaching the lesson. Seven teachers declined steadily from the first time to the third. Peterson & Clark (1978) found no patterns to link multiple implementation of the same lesson to student achievement.

Most teachers were trained to plan instruction by specifying objectives, identifying student knowledge and skills, selecting and sequencing learning activities, and evaluating outcomes of instruction (Shavelson & Stern, 1981). Research (e.g. Koeller & Thompson, 1980; Peterson & Clark, 1978; Zahorik, 1975) indicated a mismatch in prescriptive models and descriptions of how teachers actually plan for instruction. Teachers consistently showed concern for breadth and depth of content as well as the activities to support the content (Koeller & Thompson, 1980; Peterson & Clark, 1978; Shavelson & Stern, 1981; Zahorik, 1975). Despite the idiosyncratic nature of planning, these researchers pursued specific principles for curriculum planning.

In reaction to the suggestion by the official body in charge of curriculum in England and Wales’ that teachers needed a straightforward way of organizing content using tradition planning methods, Bage, Grosvenor, and Williams (1999) conducted a study to highlight the complexities of teacher planning. Bage et al. (1999) argued that
teachers’ thinking for planning could be categorized into either the *predictive planning mode* or the *responsive planning mode*. In the *predictive planning mode*, the teacher anticipated imagined future curriculum events. In the *responsive planning mode*, a teacher decided to alter a predictive plan and built sophisticated links between content and students’ learning needs through learning moments, lesson, days, and weeks. Four elementary school teachers participated in the case study. The results indicated that above all, teacher planning exists to support student learning rather than to satisfy a mandated prescription of traditional planning models. The unpredictable nature of the classroom and student learning necessitated the need for teachers to be flexible and responsive. Written lesson plans, while useful, represented crude oversimplifications of the sophisticated mental planning conducted by experienced teachers.

**How teachers should plan**

Prescriptive studies about teacher planning have been concerned with a systematic approach to developing instruction. Yinger (1980) investigated teacher planning to generate a model of the planning process that developed from actual planning behavior. His study detailed one elementary teacher over a five-month period in a Michigan school district. Yinger (1980) spent forty days observing the participant and employed process-tracing, a method “proven to be effective in studies of problem-solving and decision-making (p. 110).”

Based on the data, Yinger (1980) created a three-stage model to describe components of teacher planning and provide a basis for further theory and research on teacher planning. The general process model of planning consisted of three stages: problem-finding, problem formulation/solution (design) and, implementation, evaluation,
and routinization. Stage 1, *problem-finding*, was described as discovery of a potential instructional idea that required further planning and elaboration. Most of the planning time was dedicated to Stage 2, *problem formulation/solution (design)*, during which formulating and solving problems were portrayed as a design process. The problem was considered ill-structured due to the complexities of the classroom environment as well as the act of teaching itself; hence the goals were open to interpretation as the teacher developed and solved the problem by elaboration, investigation, and adaptation (Yinger, 1980). Stage 3 added to the “repertoire of knowledge and experience, which, in turn, become an important part of subsequent planning (p. 110).” The model, in contrast to traditional models of planning emphasized finding and developing the planning problem and planning as a design process (Clark & Yinger, 1977).

Shulman proposed a model for pedagogical reasoning in 1986, claiming that teaching began with an act of reason that required teachers to not only think about their teaching but also to perform it skillfully (Shulman, 1987). He presented six processes that operationalized pedagogical reasoning and action associated with teaching:

1. comprehension,
2. transformation,
3. instruction,
4. evaluation,
5. reflection, and
6. new comprehension.
In their research on expertise, Bond, Smith, Baker, and Hattie (2000) also identified prototypical features that affirm aspects pedagogical reasoning in expert teachers. These features will now be described as they align with Shulman’s (1987) six processes.

**Comprehension.** When planning for instruction, the first process of pedagogical reasoning is *comprehension*. Shulman (1987) suggested that a teacher should possess comprehension of both specific content and the broader educational purposes such as student responsibility and respect. Content was defined as set of ideas to be taught and how those ideas relate to other ideas within the same subject area and across other subjects. According to Bond et al. (2000), expert teachers exhibit a more integrated and coherent command of concepts and a higher level of abstraction.

**Transformation.** The second pedagogical reasoning process and most important, *transformation*, referred to a planning process during which a teacher transformed ideas from their personal comprehension to ideas that could be comprehended by learners (Shulman, 1987). According to Shulman (1987), transformation was the essence of “pedagogical reasoning, of teaching as thinking, and of planning — whether explicitly or implicitly — the performance of teaching (p. 16).”

Shulman (1987) suggested that teachers following five step model of transforming the content into an instructional plan:

1. preparation of materials,
2. representation of ideas,
3. selection of teaching methods and models,
4. adaptation of these representations, and
5. tailoring of adaptations.
This five-step *transformation* process constituted a major part of the planning process or preparation for instruction.

During Step 1, the *preparation of materials* phase of planning, expert teachers transformed the content by:

- examining and critically interprets the materials of instruction in terms of the teacher’s own understanding of the subject matter,
- detecting and corrects errors of omission and commission in the materials,
- structuring and segments the material into forms more suitable for teaching,
- scrutinizing educational purposes or goals, and
- grasping the full array of extant instructional materials, programs, and conceptions (Shulman, 1987)

In Step 2, the *representation of ideas* phase of planning, expert teachers thought through key ideas and identifying the alternative ways of representing them to students (Shulman, 1987). The product of this phase was multiple representations in the form of analogies, metaphors, examples, demonstrations, and simulations.

After a teacher planned how to represent the content, the teacher moved on to Step 3, *select teaching methods and models*. During this process, teachers drew upon an instructional repertoire of approaches or strategies of teaching to represent specific content with instructional methods or models (e.g. lecture, demonstration, cooperative learning, reciprocal teaching, discovery learning, and project methods) (Shulman, 1987). Experts were thought to represent ideas in deeper and richer ways and recognize meaningful patterns and thus create deeper more thoughtful representations making connections to prior learning (Berliner, 2001b). According to Bond et al. (2000), expert teachers were better than non-experts at adapting instruction for learners as well as improvising while teaching.
During Step 4, the adaptation of representations phase of the transformation process, teachers fitted the represented material to the characteristics of the students (e.g. ability, gender, language, culture, motivations, or prior knowledge and skills) and recognized student conceptions, misconceptions, expectations, motives, difficulties, or strategies might influence the ways in which they approach, interpret, understand, or misunderstand the material (Shulman, 1987).

Flexibility is also characteristic ascribed to experts (Glaser, 1985). Although expert teachers exhibited flexibility throughout all processes related to the performance of teaching, they were particularly adept at using their flexibility in Shulman’s (1987) Step 5, tailoring adaptations in response to the needs of the learners (Berliner, 2001b).

**Instruction.** Instruction, the third process in pedagogical reasoning, referred to as the performance that consummates all the reasoning involved in all processes, included organizing, managing, presenting, assigning work, checking work, interacting, questioning, answering, praising, and criticizing (Shulman, 1987). Pedagogical reasoning, however, does not end when instruction begins but continued during active teaching as well as in post-teaching activities such as evaluation (Shulman, 1987).

**Evaluation.** According to Shulman (1987) the evaluation process was twofold. The process included informal checking for understanding and misunderstanding while teaching as well as formal evaluation for grades. Evaluation also included examining teaching, lessons, and materials used.

**Reflection.** Reflection was the manner through which a teacher learned from experience. Central to this fifth process was a review of teaching in comparison to the planned intentions (Shulman, 1987).
**New comprehension.** As a result of engaging in any one of the previously mentioned processes, a teacher may realize *new comprehension* of purposes, subjects, students, and pedagogy (Shulman, 1987).

Because of the idiosyncratic nature of planning (John, 2006), it seemed more beneficial to use what experts generate rather than to prescribe a lesson-planning model.

**Factors that affect planning**

Although noted in the literature that experience was not an indicator of teacher expertise (Palmer et al., 2005), in lesson planning, experience did play a role. According to John (2006), experienced teachers were guided by broad intentions, intuition, tacit knowledge, and lesson images as they planned, considering content, activities, and learners simultaneously. Rarely articulating these processes, they restructured knowledge for students in a non-linear process geared toward the activity flow of lessons (John, 2006).

To study the planning process and influences on teacher planning, McCutcheon (1980) chose twelve experienced teachers at random from grades 1 through 6 from three school systems in Virginia. She and her research team were in classrooms several hours a week to study the planning process and influencing factors through observations, informal interviews, teachers’ plan books, teachers’ guides to textbooks, and student work. With respect to the planning process, McCutcheon found two important activities of planning: the plan book and mental planning. The plan book lacked details but served as a reminder that was a shorthand account of what activities would transpire based on a teacher’s mental planning. Teachers listed objectives for lessons only if their administration required them to do so and only wrote detailed lesson plans for substitutes.
Two participants maintained a folder that described their routines for substitutes. Because teachers did not write down their plans for teaching with much detail, important results of the study were revealed in the complex mental planning which involved reflecting on past lessons and envisioning what would occur in current or subsequent lessons. Mental planning by experienced teachers occurred frequently in a free-flowing manner throughout the teaching day as well as after teaching hours. In addition to administrative factors such as scheduling, class size, and evaluation, McCutcheon (1980) found that influencing factors on the planning process were:

1. Teachers relied on textbooks for continuity of lessons, that may or may not in fact be continuous.
2. A disconnect occurred between the concept of written plans of teacher education programs versus actual classroom planning that occurred mentally.
3. Lack of opportunity to discuss plans with other teachers prevented them from learning a new idea.
4. Accessibility of materials influenced what teachers took into account during mental planning.

Rather than studying experienced teachers, Sardo Brown (1993) investigated two novice teachers during their student teaching and focused on how their planning changed over time with regard to the model of planning used and the factors affecting planning practices. Consistent with other research in teacher planning (e.g. McCutcheon, 1980; Yinger, 1980; Zahorik, 1975), she found that the two novice participants first planned for content rather than stating objectives. One participant approached lesson planning in a
non-sequential but logical form of problem solving while the other participant did not
demonstrate a distinguishable approach to planning. The principle factors that affected
both the participants were the need to master content, cooperating teachers’ plans,
university professors who taught in content specialty areas, the university supervisor, the
school schedule, and the textbook. These results were consistent with factors that
influenced experienced teachers’ planning as sited by McCutcheon (1980).

Although she studied novices rather than experienced teachers, she characterized
the planning of experienced teachers as including the use of:

1. an activities-first planning model, not an objectives-first model;
2. readily available planning sources, primarily the textbook and commercially
produced materials; and
3. plans that are influenced by such factors as the school schedule and
organizational structure, subject matter, principal requirements, textbook
content, students, and other teachers. (p. 65)

Using goal statements to construct problem spaces and representations in
preparation for teaching actions, McAlpine, Weston, Berthiaume, and Fairbank-Roch
(2006) examined experienced teachers’ thinking in relation to their teaching actions.
They described a problem space as an internal representation of objects and relations that
correspond to objects and relations in the externally presented problem as well as a
collection of states of knowledge. Two participants from higher education were chosen
for this study because they had a similar amount of experience and both had taught large
classes at the introductory level. The study results indicated that the participants
described their thinking in two distinct ways: thinking about a course they were teaching
and thinking about specific classes within that course. The problem spaces at the class
level were focused on student interaction and were more concrete than those at the course
level. At the course level the participants’ internal problem spaces were focused on broad elements such as design, alignment of the course, and teaching in general. The participants also described elaborated, complex repertoires of knowledge drawn from previous knowledge and experience of teaching. As experienced teachers, the participants were able to use their knowledge and experience to define features of the context that constrain their planning and influenced the enactment of their plans.

**Routines**

Yinger (1979) defined routines as an “established procedures whose main function is to control and coordinate specific sequences of behavior (p. 165).” He identified four types of routines: activity routines, instructional routines, management routines, and executive planning routines. *Activity routines*, such as the structuring and sequencing of activities, allowed a teacher to manage a large number of activities in her classroom by routinizing as many features of an activity as possible. Strategies or styles of teaching such as giving instructions, demonstrating, instructing, monitoring, reviewing, and questioning were labeled *instructional routines*. These instructional routines were embedded in and performed as an established response to a particular activity routine. *Management routines* were not those associated with any specific activity but involved procedures such as transitions between activities or leaving the room. *Executive planning routines* were revealed as the teacher approached different types of planning (e.g. unit planning was different from weekly or daily planning). Routines were often enacted for efficiency and flexibility when actions or behaviors are repetitive. They served to automatize certain aspects of the teaching environment, reducing demands on the teacher.
Yinger’s (1979) study investigated the function and role of routines in teacher planning; describing teacher planning as the major tool by which a teacher can manipulate the classroom environment. The participant chosen for this study had been teaching for six years in a combined first and second grade classroom in a Michigan school district. To help verbalize her thought processes, the participant engaged in a think-aloud process during both informal planning sessions and deliberates ones. The results of the study indicated that nearly all classroom action and interaction took place within the boundaries of an activity, with the remaining time spent on preparation for, or transition between activities. Routines served to simplify the planning process as well as increase the predictability and decrease the complexity of the teaching environment.

In summary, descriptive studies on teacher planning showed that most teachers considered student activities as they begin the planning process rather than specifying objectives (Koeller & Thompson, 1980; Peterson & Clark, 1978; Shavelson & Stern, 1981; Zahorik, 1975). Experienced teachers rarely articulated their planning processes and were guided by intentions, intuition, tacit knowledge and mental representations (John, 2006). Teachers enacted routines to simplify the planning process, to increase predictability, and decrease complexity of the teaching environment. Additionally, routines provided efficiency and flexibility for repetitive actions and reduced cognitive demands on the teacher (Yinger, 1979).

**Expertise in Teaching**

According to Chi (2011), over the past three decades there have been four types of studies on expertise:

- individual teachers to capture the underlying processes to achieve
expertise,

• societal and environmental conditions that may contribute to expertise,

• cognitive structures to discover the talent or mental greatness for expertise, and

• how experts perform in the tasks for which they excel.

One methodological perspective for studying expertise was referred to as the relative approach (Chi, 2006). The relative approach assumed that expertise is a level of proficiency that novices can achieve and because of this assumption the definition of an expert was relative to that of a less knowledgeable group of novices (Chi, 2006). One advantage of the relative approach was that the definition of experts could be less precise and thought of in terms of prototypes. Another advantage was the tacit notion that a novice can become an expert because the expert was viewed as a relatively more advanced individual measured in ways such as experience and knowledge (Chi, 2011).

The second perspective was an information processing approach introduced along with the advent of computers (Chi, 2011; Feltovich, Prietula, & Ericsson, 2006). This approach “required … the decomposition of a complex task such as problem solving, into three components: (a) the relevant background knowledge, (b) the problem solving strategies or ways of searching through the space of all possible moves, and (c), understanding or representing the problem in terms of a space of all possible moves (p. 19).” In studying problem solving, researchers focused on structures of knowledge, differences in representations, and issues with attaining expertise (Chi, 2011; Feltovich et al., 2006).

The aforementioned approaches to studying expertise created the foundation for
work in teacher expertise. The following sections describe characteristics of expert teachers and developing teacher expertise.

**What expert teachers possess**

Overall, experts excel at generating the best solution in solving problems or the best design in designing a task (Chi, 2006). They do so through:

- automaticity (unconscious processing) and routinization (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986; Sternberg & Horvath, 1995),
- flexibility in teaching (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986),
- quick and accurate judgment, and meaningful pattern recognition (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987; Sternberg & Horvath, 1995), and
- a specialized knowledge specific to the domain of expertise (e.g. Berliner, 2001a; Peterson & Comeaux, 1987; Schempp, Manross, Tan, & Fincher, 1998; Shulman, 1987; Sternberg & Horvath, 1995).

**Automaticity and routinization.** Expert teachers often possess routinization to retrieve relevant knowledge and strategies with minimal cognitive effort and can execute their skills with greater automaticity (Berliner, 2001a; Chi, 2006; Leinhardt & Greeno, 1986; Sternberg & Horvath, 1995). The development of automaticity freed up working memory for necessary conscious processing (Glaser, 1985).

To learn how teachers established and maintained instructional routines, Leinhardt, Weidman and Hammond (1987) conducted a study of six elementary mathematics teachers identified as experts by their students’ academic achievement and administration recommendations. For this study, routines were defined as socially
scripted patterns of behavior that reduced the cognitive complexity of the instructional environment and enabled “cognitive processing space for both teachers and students by making automatic a subset of the cognitive processing tasks that would confront teachers and students if the problems for which these are solutions had to be solved anew each time (p. 135).” The results of this study indicated that these teachers introduced routines in three ways: by stating the action and supporting correct usage, by describing or modeling the actions and supporting correct use and discouraging incorrect use, and by responding to incorrect use. Routines used by the participants were classified in three categories: management or class running routines; support or lesson running routines; and exchange or interactional routines. The majority of the participants’ routines were taught on the first day of school and used regularly throughout the school year. Additionally, the strings of simple routines allowed teachers to build more complex routines (Leinhardt et al., 1987).

Carter, Sabers, Cushing, Pinnegar, & Berliner (1987) conducted an experiment to study similarities and differences in the ways teachers used information about students. Participants included eight experts, six novices, and six postulants. Postulants were described as individuals from business or industry fields who had an interest in teaching but had no formal training or experience. Each participant was provided a scenario that required that they assume responsibility and teach a class for a teacher that left unexpectedly. The participants were given 40 minutes to prepare lesson plans for two days of instruction and encouraged to take notes to help them recall information about the class and the students. After the participants created their lesson plans, they were asked to explain them. The results of Carter et al.’s (1987) study indicated that expert
participants were more likely to disregard information that was left by the previous teacher, in order to make their own judgments about the class, and to be much more evaluative of their predecessor’s techniques and practices. The expert participants felt a need to take ownership of information and the decision-making processes that influenced action. Consistent with research on experts in other fields, expert pedagogues in this study processed and stored information differently and demonstrated better memory for relevant information. The expert participants’ more highly developed schemata allowed them to quickly weigh information to judge saliency and utility in the classroom with experience providing a necessary but not sufficient condition for the development of such skills. Additionally, the researchers attributed experience to the ways in which the expert teachers immediately established new rules and routines when they took over the class.

Leinhardt and Greeno (1986) sought to describe the activity structures and routines of expert elementary teachers by first identifying such structures and routines and then analyzing frequency and duration, analyzing the functions of routines for cognitive processes, and contrasting the parts of a novice teachers’ lesson to that of an expert. They proposed a series of cognitive flow charts called planning nets to represent structures of teacher’s lesson activities such as a homework check or a presentation. Over a three and a half month period, the researchers observed, interviewed and videoed the math lessons of eight expert teachers and four novice teachers. The results generated ten categories used to describe the actions of expert teachers:

1. uninterrupted teacher presentation,
2. presentation with student interaction,
3. timed drill of facts by individuals,
4. timed drill in competitive groups,
5. checking and collecting of homework,
6. guided practice with immediate group feedback,
7. monitored practice with individual feedback and tutoring,
8. tutorials with extended presentations to individuals,
9. tests, and
10. transitions from one activity to another.

The experts constructed their lessons around a core of activities that began with presentations that involved total teacher control and then transitioned into guided group practice of problem solving. Following guided practice, students engaged in interactive independent problem solving. Their novice participants rarely engaged students in guided practice but instead jumped from presentation to independent practice. Expert teachers’ routines were flexible, multi-contextual, and required little to no monitoring or explanation. This routinization allowed for expert teachers to maximize instructional time.

**Flexibility.** Another characteristic of expert teachers was flexibility (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986). Expert teachers most often demonstrated this characteristic of flexibility through *opportunistic planning*. Opportunistic planners saw that new problem features result in changed problem representations and in response, demonstrated fast access to multiple sources of information and interpretations to solve the problem (Chi, 2006; Glaser, 1985).

Borko and Livingston (1989) investigated the thinking and actions of three novice and three expert teachers in a suburban county school systems. The researchers used
ethnographic procedures to analyze interview and observation data that revealed patterns in both novice and expert teachers’ planning, teaching, and post-lesson reflections.

Expert planners reported that most of their planning occurred outside formal planning time and was not written down. Although the expert participants did not write lesson plans, they described mental plans for their lessons, which typically included a general sequence of lesson components and content. The three expert participants had different teaching styles, but they all shared characteristics of expertise with respect to interactive teaching. The experts kept the lesson focused on the teaching objective while allowing students’ questions and comments to generate discussion, created a balance between content-centered and student-centered instruction, and when needed, created seemingly impromptu problems to illustrate or reinforce concepts and skills. Post-lesson reflections of experts focused on student understanding with little or no mention of classroom management or assessment of their own teaching. Their novice counterparts also revealed patterns in planning, teaching, and reflections. Similar to experts, novice planners had mental plans for their lessons and the plans were flexible in terms of timing, pacing, instructional examples, and problems for students to solve. However, almost all of the planning by the novice participants was short-term rather than at the chapter or unit level. With respect to teaching, the novice teachers were not as successful at translating plans into action. They also were at times unable to maintain the focus of the lesson due to a myriad of variables that tended to snowball when students pressed the novices to answer questions related to unplanned content. Additionally, novices expressed concerns related to their own effectiveness as teachers, students, and nature of the lesson in their post-lesson reflections. The researcher offered their interpretation for two main
differences between novices and experts: experience and knowledge structures. Many of the difficulties that novices experienced were due to a lack of experience. Experts in this study demonstrated efficient lesson planning skills and flexibility in the execution of these lessons by deviating from plans to be responsive to student needs.

In another study of the teaching and thinking behaviors of experts and novices, Leinhardt (1989) believed that competency differences existed in the areas of planning actions, managing action systems consistently, and building explanations of mathematical material. She referred to planning as a collection of skills that involved “(a) assembling known pieces of organized behaviors, namely, action systems or schemas', into effective sequences that meet particular goals; (b) assembling appropriate goals to meet larger teaching objectives; and (c) doing both of these in a way that attends to specific constraints in the total system (p. 53).” Leinhardt’s (1989) idea that planning occurred both before and during teaching activity was different from the notion of planning in most expert-novice comparison studies, which separated teaching into different phases. For example, Jackson (1965) believed planning occurred before teaching, or during the preactive phase. Yinger (1980) further describes the preactive phase of teaching as the ways in which a teacher spends their time in the “empty classroom” (p. 108) by grading papers, making copies, and talking with colleagues. Leinhardt (1989) assessed the lesson plans of four experts and two novices by looking at the amount of class time spent on four important segments: transition, presentation, guided practice, and monitored practice. The results indicated that expert teachers’ plans were better able to articulate planning intentions, started planning statements with gauging prior knowledge, and recognized patterns between lessons.
Quick and accurate judgment and meaningful pattern recognition. Peterson and Comeaux (1990) investigated the differences between novice and experience teachers’ recall, representation, and analysis of problem situations. They collected data from ability tests, videotaped lessons, and interviews. Their first finding suggested that experienced teachers differed in the way they interpreted classroom events. Experienced teachers had greater recall of classroom events and made significantly more statements than novices regarding reflective knowledge and analysis. The researchers attributed these characteristics to experienced teachers’ larger memory store of well-organized patterns of classroom events. A second finding was that experienced teachers’ analysis of learning situations reflected underlying knowledge structures for procedural knowledge of classroom events as well as on higher-order principles of effective classroom teaching. Their findings were commiserate with other research (e.g. Berliner, 1986; Chi et al., 1981) on expertise that reported experts provide fast and accurate pattern recognition. One major flaw in this study however is the confluence of expertise and experience. The researchers use the words interchangeably so it is not clear how, or if, they distinguished expertise from experience.

Specialized knowledge. Another characteristic of expert teachers was possessing a specialized knowledge specific to the domain of expertise (e.g. Berliner, 2001a; Peterson & Comeaux, 1987; Shulman, 1987; Sternberg & Horvath, 1995). Schempp, Manross, Tan, and Fincher (1998) studied the role of subject matter expertise in pedagogical content knowledge of physical education teachers. Ten middle school physical educations teachers participated. Schempp et al. (1998) did not consider experience as an influential factor, however the mean was 8 year. Four interviews were
used in the study: subject matter and experience, planning two hypothetical units – one in teacher’s area of expertise and one in a non-expert area, planning two hypothetical lessons – drawn from the unit plans, and a retrospective interview. The results indicated that there were significant differences between teaching subjects in which they are experts and in those in which they were not. The differences included recognition of problems in student learning, level of detail in planning, organizing subject matter, the ability to accommodate a range of learner skills and abilities, and comfort and enthusiasm for teaching. Schempp et al. (1998) also found that subject matter expertise allowed teachers to identify problems and specify remedies to overcome them and that, as found by Chi (2006), experts were more successful at choosing the appropriate strategies to use than novices. Additionally, Schempp et al. (1998) found qualitative differences in the participants pedagogical conceptions and practices: participants demonstrated varying levels of knowledge, demeanor, and competence directly based on their subject matter expertise, similarly to many other researchers (e.g. Chi et al., 1981; Glaser, 1985; Leinhardt & Smith, 1985; Livingston & Borko, 1990) who believed that there were qualitative differences in the knowledge, thinking and actions of experts.

**Developing teacher expertise**

One advantage of the relative approach to studying expertise was the notion that a novice can eventually achieve expertise (Chi, 2011). From the perspective that the expert was a relatively more advanced individual measured in ways such as experience and knowledge (Chi, 2011), researchers (e.g. Berliner, 1988; Dreyfus & Dreyfus, 1980) developed models for developing expertise.
A foundational model was created by Dreyfus and Dreyfus (1980). They drew from field methods of ethnography and de Groot’s (1965) work with expert chess players to develop a stage model of expertise for training pilots in emergency decision skills. Dreyfus and Dreyfus (1980) conducted interviews and studied field manuals to form five stages: novice, competency, proficiency, expertise, and mastery. During the novice stage, the environment within which the learner operated was context free because of a lack of experience. A beginner was provided a set of rules or guidelines for determining actions. After considerable experience demonstrated by recognizing meaningful patterns, a novice achieved competency. The guidelines of the previous novice stage were then replaced by principles. The proficiency stage required a particular perspective that enabled a learner to weigh the importance of one principle over another and chose the most appropriate from memory. Expertise was reached at a non-analytic stage of performance, when the learner responded intuitively to situations rather than relying on guidelines and principles. Dreyfus and Dreyfus (1980) claimed that although there was no higher level than expertise, an expert was capable of transcending expertise to achieve mastery by allowing “mental energy previously used in monitoring his performance go into producing almost instantaneously the appropriate perspective and its associated action (p. 14).”

Berliner (1988) adapted Dreyfus and Dreyfus’ (1980) model to teaching and identified five stages as novice, advanced beginner, competence, proficient, and expert. Berliner (1988) believed that teachers in the competence stage and proficient stage have qualities that enable them to serve as coaches or mentors because they were able articulate what they are doing at these stages. A competent teacher had two distinguishing characteristics: They made conscious choices and felt more emotional about what they
A conscious choice involved setting priorities and deciding on a plan with rational goals and sensible means for attaining them. Competent teachers felt more responsibility regarding their successes and failures in the classroom. In the proficient stage, a teacher’s intuition was prominent, but they still made analytic and deliberative decisions. Berliner (1988) described his expert as appearing fluid (effortless), flexible, and “arational (p. 5),” meaning they possessed an intuitive grasp of a situation and seemed to respond in nonanalytic, non-deliberative ways.

Using Dreyfus and Dreyfus’ (1980) stage theory of expertise, Stoddart, Pinal, Latzke, and Canady (2002) conducted a qualitative study to develop a conceptual framework and rubric to assess teachers’ understanding of curriculum integration of language acquisition in science for English language learners. In traditional approaches to teaching English language learners, subject matter content such as science is separated from the teaching of language (Stoddart et al., 2002). This study presents by Stoddart et al. (2002) presented a view similar to professional development activities for technology integration in which according to Hew and Brush (2007), “teachers have not been exposed to transformative technology-supported pedagogy because professional development activities have focused primarily on how to merely operate the technology (p. 228).” The results indicated that teachers functioned as novices when they encountered a new approach to teaching and irrespective of their teaching experience were likely to develop several different concepts on of integration as their understanding grew in complexity. Stoddart et al. (2002) also noted that the stages identified in the rubric were not linear in that teachers may skip levels as they gain more experience. One recommendation of the study was to use the rubric to assist teachers in analyzing and
planning instruction.

By identifying stages of expertise, researchers (e.g. Berliner, 1988; Dreyfus & Dreyfus, 1980; Stoddart et al., 2002) believe that teachers should be able to achieve higher levels of performance.

**Expertise in Technology Integration**

The teacher is the most important element in transforming teaching and learning and determines if technology will be successfully integrated (Chen, 2008; "U.S. Congress. OTA EHR 616," 1995; Wang & Reeves, 2004). Because the teacher is the most important factor, enhancing teachers’ technology integrating expertise is an important to increasing the likelihood that others will integrate technology. The following section identifies the conditions for successful technology integration, describe characteristics of expert technology integrators, and examines constructs for developing technology integration.

**Conditions for Successful Technology Integration**

Before characterizing technology integration expertise, it is necessary to examine conditions for successful integration. Because expertise was difficult to define (Borko et al., 1992), casting a wide net for all contributing factors to expertise rather than only focusing on teacher characteristics determined by previous literature is a better approach for understanding expertise in technology integration. Zhao, Pugh, Sheldon, and Byers (Zhao et al., 2002) categorized conditions for success into three domains: the *innovator*, the *innovation*, and the *context*. Their study explored the complex and messy process of technology integration to understand conditions under which technology innovations can
successfully take place. Zhao et al. (2002) were contracted to evaluate a grant program whose goal was to support innovative projects and to expand successful teaching and learning experiences through technology. From applications, 118 teachers or teacher teams were selected as recipients. A survey was designed to assess six constructs related to technology integration and administered to all 118 participants:

- technology proficiency,
- computer anxiety,
- attitudes and beliefs toward technology,
- previous and planned professional uses of technology,
- pedagogical styles, and
- experiences in preparing for the grant proposal.

A subgroup of 32 teachers was then selected to interview regarding previous experiences with technology, motivation for applying for the grant, and concerns and plans for implementing the technological innovation as part of the grant. From the 32 teachers interviewed, 10 were selected for case studies. These ten were determined to be representative of all 118 recipients funded by the grant and were reported in the results.

Zhao et al. (2002) observed teaching and conducted interviews at the respective participants’ school on a monthly basis during a semester of their school year. The results indicated that common factors seem to explain success in all ten cases: technology proficiency, pedagogical compatibility, social awareness, distance from pedagogical beliefs, dependence on others, human infrastructure, technological infrastructure, and social support (Zhao et al., 2002).
Innovator. With respect to the innovator domain, three factors contributed to success: technology proficiency, pedagogical compatibility, and social awareness (Zhao et al., 2002). Technology proficiency included not only the knowledge of how to use a particular technology tool but also knowledge of the enabling conditions of that tool. For example, an activity such as writing emails requires an Internet connection, networked computers, and an email program. The simple act of sending an email only works when everything else works so it is important for teachers using the email tool to have some basic troubleshooting skills.

Inan and Lowther (2010) also found similar results in their study on the effects of teachers’ individual characteristics and environmental factors in teachers’ technology integration. Questionnaire data from 1,382 teachers was collected and analyzed. The finding suggested that one of the most important factors affecting technology integration was teachers’ computer proficiency.

According to Zhao et al. (2002), pedagogical compatibility means that teachers successfully implement technology integration when the teacher’s pedagogical approach was consistent with the technology chosen to use. When teachers choose a technology that is aligned with their pedagogical orientation, integration goes much more smoothly (Zhao et al., 2002). One participant implemented an American history project that she wanted to be multi-linear and interconnected: the way humans think. Using hypertext, the participant was able to create an experience for her students that mirrored the kinds of thinking she wanted her student to learn.

The third factor related to the innovator is social awareness, or understanding and negotiating the social aspects of school culture (Zhao et al., 2002). Zhao et al. (2002)
suggested that teachers who understood the dynamics of their schools would be more likely to know where to find resources and technical support as well as how to achieve the peer and administrative support within the school and the parental support outside the school needed to successfully integrate technology in their classrooms.

**Innovation.** In addition to the teacher, or innovator, the nature of the innovation itself can impact successful technology integration in two main ways. The first is how much the technology deviates from the dominant values, beliefs, and practices of the school culture and that of the teacher (Zhao et al., 2002). If a particular innovative approach undercuts the administration’s curriculum policies, then the implementation may not be supported. The way the innovation aligns to the teacher’s pedagogical beliefs, as previously discussed, can also impact successful integration. The second main way an innovation can impact success is the degree to which the implementation of the innovation is dependent on others and on resources beyond the control of the teacher: less dependent, the more successful (Zhao et al., 2002).

**Context.** The third domain of factors influencing technology integration success is the context (Zhao et al., 2002). The context is made up of human and technology infrastructure as well as social support. *Human infrastructure* refers to a flexible and responsive technology staff to support technology use. *Technology infrastructure* deals mainly with access to computers. *Social support*, or the degree to which peers supported or discouraged the participants’ implementation of innovations, also contributed to overall successful implementation (Zhao et al., 2002).

Groff and Mouza (2008) used Zhao et al.’s innovator, innovation, and context model to create their own model called the *Individualized Inventory for Integrating*
Instructional Innovations (i5) to provide practical assistance for teachers as they integrate technology and “thereby increasing the likelihood of achieving success” (p. 22). Groff & Mouza (2008) did not conduct an actual study to develop or test their model. They operationalized Zhao et al.’s (2002) work by culling research in conditions for success and provided a hypothetical vignette of how they envisioned the use of their model in a real world context. The model is thorough in terms of incorporating Zhao et al.’s (Zhao et al., 2002) conditions for success. From the looks of the model, extensive training would need to take place to educate both evaluators and evaluatees on the constructs included in the model.

Bitner and Bitner (2002) created a list of eight areas to consider for successful technology integration: fear of change, training in basics, personal use, teaching models, learning based, climate, and motivation. Bitner and Bitner (2002) claimed that using technology as a teaching and learning tool brings about fear, anxiety, and concern because it involved changes in both classroom practices and the use of unfamiliar technologies. Helping teachers overcome these fears was crucial to successful implementation. Teachers also needed a basic knowledge of computer use and personal productivity can be used to foster both basic knowledge and teacher interest. In order to conceptualize how technology facilitated teaching and learning, teachers needed models in which learning drove the use of technology. According to Bitner & Bitner (2002), a supportive climate for technology integration allowed teachers to experiment without fear of failure. Viewing this kind of failure as a positive event provided motivation to endure the frustration of the change process required for successful technology integration (Bitner & Bitner, 2002).
In an attempt to address the conditions necessary for frequent, high-quality use of computer in teachers’ everyday instructional practices, Becker and Ravitz (2001) conducted a survey of more than 4,100 teachers in over 1,100 schools. The results indicated that reasonable amount of computer knowledge, convenient access to enough computers, and a teaching philosophy that favors a constructivist-oriented (e.g., project-based, inquiry-based) teaching practice were the most powerful factors in successful technology integration. According to Becker & Ravitz (2001), contextual factors such as block scheduling and 5-8 computers located in the classroom contributed to how often computers were used. Factors that related to teachers were technical knowledge and pedagogical beliefs. Teachers with knowledge of computers for professional use and teachers who had computer skills were more apt to integrate technology into their instruction. Teachers who were most traditional in their pedagogical beliefs were less likely to integrate technology than those who held a more constructivist view.

**Exemplary technology integrating teachers**

However researchers described conditions for successful technology integration expertise, the teacher is the most important factor (Chen, 2008; "U.S. Congress. OTA EHR 616," 1995; Wang & Reeves, 2004). Referred to as the Bank Street study, Hadley and Sheingold (1993) surveyed 608 teachers from grades 4 – 12 all over the United States who were identified as experienced at integrating computers into their teaching. The 16-page survey included sections on teaching practices using technology, barriers to integration, incentives to integration, perceived changes in teacher as a result of technology integration, descriptive information about training, experience, and views of technology. The results indicated that overall the participants were knowledgeable about
and comfortable with the use of computers in their teaching, putting technology to use in multiple ways for many different instructional purposes. The participants seem to take a flexible approach to their teaching with technology, emphasized a student-centered learning environment, and possessed at least five years of experience teaching with technology (Hadley & Sheingold, 1993). The participants derived incentives for using technology from their personal and professional gratification as well as from student engagement and learning. Although the participants acknowledged barriers to technology integration such as inadequate administrative support, time, access, outdated software/hardware, and lack of maintenance and support, these factors did not seem to prohibit technology integration in this population.

Becker (1994) examined how exemplary technology-using teachers differ from other teachers by conducting a survey. Out of 516 teachers, 45 were identified as experts. The study results indicated differences in teaching environments, personal backgrounds, and teaching practices. Four characteristics of the teaching environment contributed to exemplary computer use: a social network of computer-using teachers at the same school, sustained computer use in which the computer is used as a tool for learning, organized support in the form of staff development or a dedicated computer coordinator, and resources for effectively using computers. Exemplary teachers taught in an environment that enabled them to become better technology integrators; they were better prepared to use computers in their teaching; and they allowed computers to have an impact on how and what they teach (Becker, 1994).

Ertmer, Gopalakrishnan, and Ross (2001) conducted an exploratory study to compare the characteristics and practices of 17 teachers who perceived themselves to be
experts and who demonstrated characteristics and practices of expert teachers described in the literature. The researchers analyzed open-ended questionnaires, interviews, and observational data. The findings were discussed in terms of teaching and technology experience, confidence and innovativeness, and support and resource availability.

Although literature (e.g. Becker, 1994; Hadley & Sheingold, 1993) suggested that expert technology integrators should have several years experience and computer training, Ertmer, et al. (2001) found that the self-perceived expert participants in their study had less experience, they but suggested the participants’ levels of expertise were due to an increased emphasis on technology training in pre-service teacher programs rather than their years experience. Consistent with literature (e.g. Marcinkiewicz, 1993), participants in this study expressed high levels of confidence in using and teaching with technology as well as innovativeness. Specifically, teachers’ confidence was evident in their creative approaches to work around constraints and obstacles that tended to interfere with technology integration such as lack of time and resources (Ertmer et al., 2001). Becker (1994) reported that expert integrators tended to work in school districts that have made investments in staff development and on-site support. Hadley and Sheingold (1993), however, found that most experts taught themselves technology skills. Ertmer et al.’s (2001) affirmed both these propositions regarding technology integration expertise.

Although Ertmer et al.’s (2001) defined exemplary technology integrators as teachers who subscribe to constructivist practices, important to note is that computers use alone do not lead to constructivist practices. Windschitl and Salh (2002) conducted a multicase study to explore the connections between computer use and constructivist pedagogy. Data collected from three teachers indicated that the influence of ubiquitous
technology on instructional practices was mediated by beliefs systems about learners, what constituted good teaching, and the role of technology for student learning (Windschitl & Sahl, 2002). Belief systems influenced what was appropriate and possible in their classroom. As part of the data collection process, teachers listed affordances and constraints of technology and indexed them against the potential for that technology to create learning conditions aligned with their beliefs about learners and learners’ needs. The pervasiveness of technology did not transformation teacher practices from traditional to a constructivist orientation.

Expert technology integrators were characterized by some level of teaching experience and confidence in using technology whether it is for personal or professional use (Becker, 1994; Hadley & Sheingold, 1993; Marcinkiewicz, 1993). They took a flexible, creative, and innovative approach, emphasizing a student-centered learning environment (Ertmer et al., 2001; Hadley & Sheingold, 1993; Meskill, Mossop, DiAngelo, & Pasquale, 2002). This type of approach and teachers’ confidence allowed them to overcome constraints and obstacles that tended to interfere with technology integration such as lack of time and resources (Ertmer et al., 2001). Expert teachers also taught in an environment that enabled them to become better technology integrators either by knowing who to contact for support or how to support themselves (Becker, 1994).

**Developing technology integration**

Several models have been developed to assist teachers with developing technology integration expertise. The Apple Classrooms of Tomorrow (ACOT) model was developed in 1984 as part of a four-year collaboration between Apple Computers,
Inc. and several school districts to explore the “impact of computer saturation on teaching and learning.” (Dwyer, Ringstaff, & Haymore, 1994, p. 1) Dwyer et al. (1994) analyzed 32 teachers’ audiotapes of personal reflections, weekly summaries, observations, and interviews to create the ACOT stages of technology integration: entry, adoption, adaptation, appropriation, and invention. The *entry* stage referred to a teacher with little to no experience with technology. *Adoption* occurred as teachers struggled to accommodate new technology with a reliance on technology use to support traditional text-based instruction. Productivity increased as a result of access to technology, allowing teachers to have more time to engage students in higher level learning with technology. This was referred to as the *adaptation* stage. Movement to the *appropriation* stage hinged on a teachers’ personal mastery of technology and the ability to “use it effortlessly as a tool to accomplish real work (p. 6).” In the final stage, *invention*, teachers were ready for a purposeful change in teaching and learning. “They are ready to invent interdisciplinary learning activities that engage students in gathering information, analyzing and synthesizing it, and ultimately building new knowledge on top of what they already know (p. 9).”

Pierson (2001) explored the strategies of exemplary technology-using teachers using the stage model of teaching expertise of Berliner (1988) combined with the Apple Classroom of Tomorrow (ACOT) model developed by Dwyer, Ringstaff, & Sandholtz (1991). Pierson (2001) referred to exemplary technology use as being by teachers with exceptional personal and professional computer knowledge who used computers as part of daily learning activities. Using the aforementioned, stage models (entry, adoption, adaptation, appropriation, and invention), Pierson (2001) identified three participants as
having a combination of expertise in teaching and adequate technology integration, adequate in teaching ability and expertise in technology integration, and expertise in both.

Findings led to the following assertions about technology integration.

• Teachers used and managed technology based on their personal beliefs regarding the definition of technology integration.

• Some teachers mistook computer use for technology integration and used computers as a reward for good behavior based on their personal definition.

• Teachers at lower levels of technology ability or teaching ability changed their planning and assessment practices to accommodate for technology integration.

• Experts did not alter their planning habits for lessons with or without technology and with respect to assessment; content was the priority rather than the technology skill.

• Personal learning strategies influenced the ways in which teachers taught with and about technology: one participant was structured to maintain control and another wanted students to be independent learners.

Moersch (1995) introduced The Levels of Technology Implementation (LoTi), the Personal Computer Use (PCU) and Current Instructional Practices (CIP) instruments a conceptual framework to assist school districts in restructuring curricula to include authentic uses of technology. The PCU measured skill and comfort level of technology for personal use by levels of intensity ranging from zero to seven. CIP also used levels of intensity ranging from zero to seven to measure how teachers’ current classroom practices related to a student-centered classroom. Moersch (1995) proposed seven levels of technology implementation and the corresponding changes to instruction that can be
observed. *Nonuse* (level 0) is lowest level and was referred to as a lack of access or lack of time to pursue implementation. The next level was *awareness* (level 1) meaning the teacher knew about a particular tool but did not connect relevance to instruction. Technology based tools supplemented instruction during the *exploration* level (level 2) and augmented instruction at the *infusion* level (level 3). *Integration* (level 4) occurred when technology based tools provide a context for student understanding and promote problem solving. When a teacher used technology to extend learning beyond the classroom, they achieved *expansion* (level 5). *Refinement* (level 6) represents the highest level of implementation in which the technology is a process, product, and a tool for solving authentic problems.

Rakes, Fields, and Cox (2006) used the LoTi, PCU, and CIP instruments to investigate the relationship between technology use and constructivist instructional practices in 186 fourth and eighth grade teachers. They found that in their sample, the predominant LoTi level was level 0, or nonuse, which accounted for 35% of their participants. The rest of the population fell between levels 1 and 4. According to the PCU, almost 50% rated themselves at or below moderate skill levels. With respect to constructivist practices, 27% reported comfort with implementing a learning-based approach and 24% indicated that they currently practiced this type of approach. According the data, Rakes et al. (2006) could not find a statistically significant link between levels of technology integration and constructivist practices. They did, however, find that personal use was positively correlated with constructivist practices and high levels of technology implementation and personal use contributed to constructivist practices.
Another option for developing technology integration was to identify content-based activity types before learning to integrate technology, based on the assumption that “appropriate and effective instruction with technology is best planned after teachers are familiar with the complete range of learning activity types” (p. 12) in a content-related discipline (Harris et al., 2009). Activity structures were comprised of parts of lessons (e.g., “KWL activities”), each of which has a particular focus, format, setting, participants, materials, duration, pacing, cognitive level, goals, and level of student involvement (Stodolsky, 1988). Harris et al. (2009) identified 42 learning activity types from structural analyses of social studies learning activities and reported in curriculum, research, pedagogical journals, and/or social studies methods texts. By aligning technology options to specific activities, preservice teachers could start with the options listed and build upon these as they realized successes or failures in implementing them.

**Planning for Technology Integration**

Tubin and Edri (2004) studied the planning processes of teachers integrating technology and its impact of planning on implementation. This case study took place at a small elementary school with twelve teachers with an average of 20 years experience. Three patterns of planning were identified as a result of the study: the “flow” pattern, the “flexible” pattern, and the “fulfiller” pattern (p. 184). The flow pattern referred to a general outline of a planning, leaving the details to the implementation process as they emerge and merely responding to ongoing events. Teachers who used this type of planning described themselves as flexible, spontaneous, and open to change (Tubin & Edri, 2004). Teachers planning in a flexible pattern assumed that change could take place during implementation of those plans. If technology obstacles arose such as computers
shut down, it was necessary to change plans. The *fulfiller* pattern of planning was structured and procedural. Teachers employing this type of planning believed that organization was one of the most important tools in teaching (Tubin & Edri, 2004). Of the three patterns, Tubin and Edri (2004) found that *flexible* planning was the most efficient because flexible plans considered a changing environment and was compatible with characteristics of technologies used in teaching.

Lim and Chai (2008) observed and interview six elementary school teachers in Singapore to examine how teachers’ pedagogical beliefs affect the planning and conduct of the computer-mediated lessons. Of the 18 lessons observed, 80% contained some constructivist elements in which technology was used as a tool for information, data collection, simulation, and scaffolding of lessons. However, traditional elements in terms of teaching style (e.g. teacher as knowledge authority), learning goals (e.g. behavioral), and assessment strategies (e.g. finding the correct answer) were also evident in 14 of the 18 lessons. Based on the interview data, five of the six teachers indicated constructivist beliefs but created lessons that were more traditions. The participants attributed this to factors outside their control such as scheduling, school-wide emphasis on testing, and object-driven curriculum. This inconsistency in practices and beliefs was supported by Windschitl and Salh (2002).

Richardson (2009) conducted a phenomenology study to determine the types of decisions and thought teachers make as they plan for technology integration. She interviewed and observed 12 fifth, sixth, and seventh grade content area teachers in three rural southeastern US school districts as they planned for and used digital technologies as part of their lesson plans. The conceptual framework for the study was Technological
Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006; Koehler & Mishra, 2009). The data collection method was called a planning-observation-reflection cycle in which the researcher talked to teachers as they prepared a lesson, observed the lesson, and talked to the teacher again to reflect on changes in knowledge (Wilson, Shulman, & Richert, 1987). Richardson’s (2009) results indicated that teachers generally follow Shulman’s (1987) model of pedagogical reasoning and action as they planned for and implemented lessons. The participants incorporated technology into their existing practices and routines that could be aligned to content-based activity types (Harris et al., 2009). Lastly, the participant developed routines focused around technology so seamlessly that they did not separate technology use from regular planning routines.

**Summary**

The chapter included a review of the literature related to teacher planning, expertise in teaching, and expertise in technology integration. The literature on planning indicated that experienced teachers focused on activities rather than objectives and rarely articulated their planning processes (John, 2006). Routines provided efficiency and flexibility for repetitive teaching actions and free up cognitive demands for more complex actions associated with teaching (Yinger, 1979). Expert teachers were characterized by problem solving skills that include routinization automaticity and routinization (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986; Sternberg & Horvath, 1995), flexibility in teaching (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986), quick and accurate judgment, and meaningful pattern recognition (e.g. Berliner, 2001a; Leinhardt &
Greeno, 1986; Peterson & Comeaux, 1987; Sternberg & Horvath, 1995), and a specialized knowledge specific to the domain of expertise (e.g. Berliner, 2001a; Peterson & Comeaux, 1987; Schempp et al., 1998; Shulman, 1987; Sternberg & Horvath, 1995). Expertise in technology integration included the aforementioned characteristics of teaching expertise with the addition of confidence (Becker, 1994; Hadley & Sheingold, 1993; Marcinkiewicz, 1993), and creative approaches to student-centered learning environment (Ertmer et al., 2001; Hadley & Sheingold, 1993; Meskill et al., 2002).
CHAPTER 3

METHODOLOGY

As discussed in Chapter 1, technology integration involves the representation of concepts and application of pedagogical techniques using technology in a constructive manner (Koehler & Mishra, 2009). Decisions regarding the most appropriate technology to represent and transform content continue to challenge teachers as they attempt to meet the demands of the 21st century classroom. From the perspective of the teacher as a problem solver, expert technology-integrating educators build deeper problem representations; recognize meaningful patterns; demonstrate flexibility – changing representations when appropriate; and develop automaticity to process more complex information (Berliner, 1986, 2001b). A significant reason for studying expert teachers was that they can provide “richly detailed descriptions of instructional events” from which we can learn (Berliner, 1986, p. 6). Stake (2000) claimed that the purpose of any inquiry was to benefit the intended audience (e.g. educational researchers) and promote understanding.

Case study was chosen as the most appropriate methodology for this study because it provided a more effective way of adding to the understanding of teachers’ experiences (Stake, 2000). This chapter discusses case study design, data collection, and data analysis used to answer the research objective, which is to describe the planning strategies that expert teachers, identified as TIA recipients, used in designing technology-integrated instruction. The main research objective was: How do expert teachers plan for technology-integrated instruction? The research questions associated with this objective were:
1. How do expert teachers negotiate the planning task environment?

2. How do expert teachers negotiate the planning problem space?

The chapter also describes the methodological issues including concerns regarding limitations, reliability and validity.

**Research Design**

Several definitions exist for case study research. Yin (2009) defined case study in terms of the research process: “A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (p. 18). Merriam (2009) defined case study as “an in-depth description and analysis of a bounded system” (p. 40). Merriam’s (2009) notion of a bounded system and Stake’s (1995) idea of an integrated system best articulated the case as a unit around which there were boundaries (Merriam, 1998). Stake (2006) claimed that the first objective in case study was to understand the unit of study or the case, by bounding the context, and Merriam (2009) viewed case study as the end product of an investigation. I align myself with Merriam’s definition of case study as a methodology, but draw from Stake’s idea of the researcher as interpreter.

Integrating technology into teaching is a complex, unpredictable, and ill-structured problem (Koehler & Mishra, 2009; Mishra & Koehler, 2006). As teachers plan for technology integration, they attempt to solve this ill-structured problem, and in doing so consider multiple variables including but not limited to the curriculum, the physical classroom, the class size, time available to teach, resources, individual student
characteristics, teacher knowledge and experience, decisions regarding how best to represent the content, and activities to facilitate learning of the content. Case study methodology can be used to investigate complex units of study consisting of multiple variables such as these with potential importance to understanding the phenomenon (Merriam, 1988).

Teachers plan through a variety of processes that are highly individualistic, idiosyncratic, and embedded in the course content and classroom context of the lesson being planned (John, 2006). The case study design was particularly suited to address teacher planning for technology integration because case study was used to gain an in-depth understanding of “process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation” (Merriam, 1998, p. Location 299).

Planning occurred not only in the “empty classroom” (Yinger, 1980), but also at odd moments outside of the teaching day such as when watching television or taking a shower (McCutcheon, 1980). This place where planning occurs was represented by a range of both external and internal factors as described in Chapter 1. The place, however it is not actually bound by context or time; it is a metaphorical space captured in the teacher planning problem space, which served as the context for this study (see Figure 8). The unit of analysis for this case was how the individual TIA award winners’ negotiated the teacher planning problem space (Figure 8). The act of teaching was outside the unit of analysis.
Case study offered what Merriam (1998) described as a holistic account of a phenomenon that is particularistic, descriptive, and heuristic. These characteristics of case study allowed for a more complete representation of technology integration situated in the context of teacher planning. The special features of case study in combination with the conceptual framework contributed to defining the teacher planning problem space.

**Particularistic.** Particularistic nature of case study refers to a focus on a particular situation or phenomenon, which makes case study an especially good design for practical problems such as experiencing difficulty with technology integration (Merriam, 1998). The particular situation in this study was planning for technology-integrated instruction. The conceptual framework of this study combined the notion of a problem space (Simon & Newell, 1971) with a process model of teacher planning (Yinger, 1980) to focus on the multiple factors that teachers consider as they plan for instruction with technology. This conceptual framework included both external and internal factors that influence planning. The external factors that influenced planning were captured in the planning task environment and included the curriculum, classroom, class size, school schedules, resources available, and student abilities. The internal factors such as knowledge and experience that contributed to how a teacher plans
occurred, according to the conceptual framework, in the *planning problem space*. A particularistic nature of case study allowed the researcher to narrow the focus of the study on one specific aspect of teaching: planning.

**Descriptive.** Because teaching with technology is viewed as an ill-structured problem to solve and is situated in the context of the *teacher planning problem space*, the descriptive characteristic of a case study helps to illustrate the complexities involved in planning. According to Merriam (1998), case study include as many variables as possible and portray their interactions. The conceptual framework described in Chapter 1 portrays several factors that contribute to the *planning task environments* and *planning problem space* and can influence planning. A detailed, descriptive account the planning phenomenon can be used to illustrate support or challenge assumptions of previous literature on expertise in teacher planning for technology integration.

**Heuristic.** The heuristic nature of case study is similar to Stake’s (1995, 2000) notion of instrumental case study in that case study can illuminate the reader's understanding of the phenomenon either by the discovery of new meaning, extending the reader's experience, or confirming what is known (Merriam, 1998). Applying this unique framework to a rather esoteric process may provide heuristics for expertise in planning technology-integrated instruction that can explain how experts face challenges.

The special features of a case study, the *particularistic, descriptive, and heuristic* characteristics, are well suited to illustrate the complexities of studying the process of planning for technology integration by expert teachers. I therefore conducted a single case study to specifically examine how teachers negotiated the *teacher planning problem space*. 
Framework of Design

The teacher is a problem solver who uses planning to address the ill-structured problem of technology-integrated instruction. The problem-solving planning process is understood through the lens of the teacher planning problem space, which is a combination of Newell, Shaw, and Simon’s (1958) notion of problem space and Yinger’s (1980) process model for teacher planning. In this study, a teacher planning problem space provides the analytical framework for teacher expertise in planning for technology integration in this study. The case in this study was bounded by the teacher planning problem space, in which a teacher contends with external elements called a planning task environment and internal elements called a planning problem space. The framework provided a comprehensive structure to analyze expert teacher planning for technology integration.

External variables. The planning task environment provides a structure for identifying variables outside of the teacher’s control, or external variables, that influence planning thoughts, decisions, and judgments when planning for technology integration. Before planning occurs, a teacher must know what to teach, which is often determined by state or national curriculum. In addition to the mandated curriculum, a teacher must consider the school and learning environment. When teachers plan for technology integration, they also choose technology tools to help support the content. One important factor that can impact technology integration is the availability of technology resources (Ertmer, Ottenbreit-Leftwich, & York, 2007). The framework of this study provided a guide to look for patterns in how teachers consider resources available and at what point...
in the planning process they determine the best resource to address the curriculum. Learning how and where in the planning process teachers select resources may prove useful for teachers who struggle with meaningfully integrating technology into their instruction.

**Internal variables.** Thoughts, decisions, and judgments occur in the internal or mental part of the teacher planning problem space and are referred to as the planning problem space. Schemas were used to represent expert technology integrating teachers’ thoughts, decisions, and judgments. Expert teachers are believed to have more complex schemas, which represent knowledge, as well as more experience than their novice counterparts (Borko et al., 1992; Borko & Livingston, 1989; Clark & Peterson, 1986; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987). Furthermore, an expert technology-integrating teacher employs technology in learner-centered environments (Becker & Riel, 1999; Ertmer et al., 2001). The components of the planning problem space (e.g. problem statement, design space, and goal state) provide the structure for analyzing the mental space in which teachers plan. How expert technology integrating teachers organize knowledge and experience through the lens of a planning problem space to can provide a window into planning decisions these experts make.

**Bounds of the Case**

Case studies can be differentiated from other types of qualitative research in that they are intensive descriptions and analyses of a bounded system (Merriam, 1998; Smith, 1978). According to VanWysberghe and Khan (2007):

The classroom, for example, is spatially bound in a formal institutional setting with an established space, set schedule, shared expectations, and
often a prescribed curriculum. These boundaries enable classroom researchers to develop focused hypotheses by circumscribing what is inside and outside of the case (p. 4).

Boundedness is an important part of case study research (Merriam, 1998). Any case has an outside and an inside boundary—certain components lie within and certain features lie outside the boundaries of the case (Stake, 2006). In case study research, drawing lines to mark these factors that may be outside the boundaries of the case yet contribute to components inside the boundaries of the case it is often difficult and arbitrary. In this study, however, the bounds are distinct: winners of the Teacher Innovation Award. All participants were identified as experts based on this designation.

**Participants**

The participants for the study were purposefully selected based on the assumption that to discover and gain insight, a sample should be selected from which the most can be learned (Merriam, 2009). The initial pool consisted of thirty-two teachers or media specialists who won the Teacher Innovation Award (TIA). What was relatively unique about this award and part of rationale for using it to identify experts was that the applicants were not nominated or voted winners by students or coworkers. Instead, applicants entered on their own volition and were judged on the merit of their submission by a panel; therefore the award could not be perceived as a popularity contest.

The panel of judges included previous winners, PBS online professional development facilitators, educational advisors to The Henry Ford, and representatives from education related professional content organizations (PBSLearningMedia, 2012). As part of the application process, entrants submitted a video clip or PDF of an
instructional activity demonstrating innovation (see Appendix A). All entries were judged on the following criteria:

- innovation/originality/creativity,
- application or reinforcement of 21st century learning skills,
- effective integration of digital media,
- student engagement, and
- student learning (PBSLearningMedia, 2012).

The criteria by which these winner’s were judged is in keeping with Ertmer, Gopalakrishnan, and Ross’ (2001) characterization of a technology integration expert.

Permission to contact all thirty-two winners was granted by Georgia State University’s Institutional Review Board (IRB). From the initial pool of thirty-two winners, email addresses for twenty-eight innovative teachers were obtained through Internet searches. An initial email was sent to twenty-eight TIA winners to solicit participation in the study (see Appendix B). The consent form (see Appendix C) was included as an attachment in the initial email. Six TIA winners responded to the request to participate and attached a signed consent form in a subsequent email. After signed consent forms were obtained, the participants were emailed a link to a survey (see Appendix D) to collect demographic information and gauge basic levels of technology use.

The six winners of the Teacher Innovation Award sponsored by PBS Learning Media and The Henry Ford who agreed to participate in the study consisted of three females and three males. Pseudonyms were used to protect the identification of the
participants. They were informed that due to the public nature of the award and their own accomplishments as experts, it was impossible to guarantee anonymity.

The participants represented a range of teaching experience as well as backgrounds including elementary, middle, and high school teachers, media specialist, and instructional technology specialists from the Midwest, Southeast, and Southwest. Two of the six participants were in elementary schools; the other four were in secondary schools. Four were classroom teachers and two served in instructional technology support roles. Of the classroom teachers, two were art teachers: Felicity taught elementary and Megan taught high school students. The other two classroom teachers taught at the secondary level: one taught math and the other taught science. Teaching experience ranged from four to twenty-one years with three teachers having the same number of years of experience at sixteen. The two participants in the instructional technology support role were Brandon and Laurie. Brandon was an Instructional Technology Specialist for middle school and worked with both teachers and students. Laurie was a media specialist at an elementary school. Ronan taught both middle and high school students. Henry and Megan taught high school students with the exception of Megan who had an occasional 8th grade student in her classes. Table 1 provides a summary of the demographic information.
Table 1. 

*Participant Demographics*

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Gender</th>
<th>Race</th>
<th>Position</th>
<th>Age</th>
<th>Subject</th>
<th>Exp</th>
<th>Grade(s) taught</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandon</td>
<td>M</td>
<td>W</td>
<td>Instructional Technology</td>
<td>48</td>
<td>Language Arts,</td>
<td>16</td>
<td>6 – 8</td>
<td>M.A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specialist</td>
<td></td>
<td>Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Felicity</td>
<td>F</td>
<td>W</td>
<td>Art Teacher</td>
<td>44</td>
<td>Art</td>
<td>21</td>
<td>K – 5</td>
<td>M.A.</td>
</tr>
<tr>
<td>Henry</td>
<td>M</td>
<td>W</td>
<td>Physics Teacher</td>
<td>50</td>
<td>Physics</td>
<td>12</td>
<td>9 – 12</td>
<td>Ph.D.</td>
</tr>
<tr>
<td>Laurie</td>
<td>F</td>
<td>W</td>
<td>Media Specialist</td>
<td>37</td>
<td>All</td>
<td>16</td>
<td>K – 6</td>
<td>Ed. S.</td>
</tr>
<tr>
<td>Megan</td>
<td>F</td>
<td>W</td>
<td>Art Teacher</td>
<td>51</td>
<td>Art</td>
<td>16</td>
<td>9 – 12</td>
<td>Ph.D.</td>
</tr>
<tr>
<td>Ronan</td>
<td>M</td>
<td>W</td>
<td>Math Teacher</td>
<td>28</td>
<td>Math</td>
<td>16</td>
<td>6 – 10</td>
<td>M.A.</td>
</tr>
</tbody>
</table>

Note: M = Male. F = Female. W = White. Subject = main subject area the participant teaches. Exp = number of years experience in teaching. Degree = the highest degree achieved.

**Research Context**

A case is a complex entity located in its own situation with special contexts and backgrounds (Stake, 2006). The research context in this case study occurred online mediated through the use of technology. The decision to conduct the research in an online setting was made because the participants were geographically dispersed and online communications would provide a convenient way to interact with them (Salmons, 2011). The online context included email as well as videoconferencing via Skype and Google Hangout. Skype is a video chat service that allows people make audio and video calls using an Internet connection. Google Hangout is a similar service. Online conversations were scheduled in advance via email and the researcher and each participant met online using either Skype or Google Hangout to discuss information related to the study.
Researcher Background and Role

My role in this study was consistent with Stake’s (1995) notion of an interpreter. I used data collected to provide thick descriptions and what Stake (1995, p. 102) referred to as integrated interpretations of the situations and contexts of expert teachers’ planning processes for technology integration. In the following section, I acknowledged the potential areas of subjectivity based on my experiences.

As an educator of both students and teachers, I have knowledge of, and experience in what Stake (2000) called the special languages that teachers posses as a result of their experiences in the classroom. I also have the somewhat unique perspective of integrating technology as a high school classroom teacher, as well as serving as an instructional technology specialist (ITS) for an urban school district.

As a classroom teacher, I wrestled with integrating technology into my mathematics courses. I had successful lessons and unsuccessful ones. My background as a classroom teacher may be similar to the background of the participants in this study. As a researcher, I therefore needed to separate my role as a researcher from my previous role as a teacher and try not to make assumptions based on my prior experiences. To bring awareness to assumptions about what might be a shared language, I maintained an open mind as I communicated with participants. Dey (2003) argued that “there is a difference between an open mind and empty head” (p. 65); hence, experience played a role but the shared language was explored to check for multiple meanings. During interviews, I asked clarifying questions and probed participants to explain statements further to understand the meaning from their perspective rather than my own. I also wrote analytic memos to capture my thoughts as I read through participant transcripts.
For example, as participants reflected on their teaching during interviews, I recognized that I compared and contrasted my experiences with theirs. I wrote memos after interviews to distinguish assumptions about teaching associated with my experiences and noted similarities and differences with participants’ experiences.

In my role as an ITS, I have had the opportunity to observe teachers of all grade levels struggle with, or completely ignore technology integration in their instruction. As an ITS, I served teachers in two main capacities: technical support and instructional problem-solver. I considered technical support as two-fold: machine maintenance and technology tool training. My position, however, was commonly misunderstood by teachers as being as technical support rather than instructional technology support. Common questions were: Can you fix my printer? Can you install software on my computer? Can you reset my password? Although I did have some knowledge and experience with troubleshooting computer and printer issues, the district placed limitations in my ability to fulfill these requests. One area in which I was able to help teachers was with technology tool training. In my experience as an ITS, teachers often wanted to use a particular tool in their instruction. If teachers requested to use a particular tool, then my job was to learn how to use the tool myself and teach them how to use it in an instructional context.

The most important and fulfilling part of my job was that of instruction problem-solver. Quite often a teacher requested support by stating that they would like to use technology. The cycle of support that I used, stipulated by the Instructional Technology Department, consisted of three parts. The first part was with a planning session during which we determined what the students were to produce as a result of their instruction. In
the second part of the cycle, I modeled the implementation of the technology-integrated lesson. The third part of the cycle involved the teacher taking over instruction with my support.

I believe that technology integration should be driven by the curriculum rather than being technocentric. Technocentricism is the misconception that technology will solve instructional problems (Papert, 1987). Technocentric approaches focus on the technology tool at the expense of content and pedagogy (Harris et al., 2009). For example, technocentric teachers associate doing an activity on the computer with improving mathematics or writing skills. Teachers may believe they are successfully integrating technology simply because they have planned for the use of technology in a lesson, a perception which adds to the challenges teachers face when integrating instruction.

All researchers have inherent subjectivity based on cultural beliefs and other factors. Because I believe technology integration should be curriculum-driven rather than technocentric, I am prone to preconceptions of what constitutes effective technology integration. Strategies I used for minimizing subjectivity included asking probing questions, memoing my thought processes, and peer debriefing. I focused the participant’s perspective of their experience and maintained an outsider’s view by monitoring my potential subjectivity through memoing (Ertmer, Addison, Lane, Ross, & Woods, 1999; Merriam, 2009). To mediate potential subjectivity regarding what it meant to integrate technology as well as other negotiated terms, I used peer debriefing and member-checking as I collected and analyzed data. Transcripts of each of the three interviews were sent to each of the six participants to check for accuracy.
After I analyzed and synthesized participant data, I sent them a copy of the report as well as my interpretations to make sure they were represented in an ethical manner. My role as the researcher was not to represent how all teachers plan for technology integration for the sake of generalizing planning strategies but to represent the case in this study in a manner that created an extent of these six teacher’s experiences that would be relatable or transferable to some aspects what all teacher experience.

**Data Collection**

Data were collected over an 18-week period starting in August 2013 and ending in December 2013. A variety of data were collected including a survey, interviews, documents, and audio-visual material. Data were analyzed as they were collected to maintain reliability and trustworthiness and to allow time for member checking throughout the process of data collection. Table 2 provides a summary of the data collected. Elaborations on each type of data are provided in the following sections.

Table 2.

*Data collection overview*

<table>
<thead>
<tr>
<th>Type of Data</th>
<th>Research Question Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online survey</td>
<td>How do expert teachers plan for technology-integrated instruction? (External: the <em>planning task environment</em>)</td>
</tr>
<tr>
<td>Interviews (3)</td>
<td>How do expert teachers plan for technology-integrated instruction? (External: the <em>planning task environment</em> and internal: the <em>planning problem space</em>)</td>
</tr>
<tr>
<td>Lesson artifacts</td>
<td>How do expert teachers plan for technology-integrated instruction? (Internal: the <em>planning problem space</em>)</td>
</tr>
</tbody>
</table>
Survey

A ten-question survey link was emailed to participants to collect some background information from the participants (see Appendix D). The survey was facilitated through Survey Monkey, an online survey software program.

The first section of the survey asked for demographic information about the participants such as age, number of years teaching, subjects taught, grade levels taught, and education level.

The second section of the survey included questions to assess the technology available to the participants as well as what kinds of technology the participants use and require their students to use. The rationale for asking participants about the availability of technology was that it might impact their planning decisions.

Three questions from the third section of the survey were directly related to planning practices. The first question asked participants about school-based requirements for turning in lesson plans. The second and third questions drew from the literature on planning. One question referenced Tubin and Edri’s (2004, p. 184) terms for three patterns of planning: the flow pattern, the flexible pattern, and the fulfiller pattern (see Chapter 29). The final question on the survey asked participants to rank the order in which they make planning decisions. This question pulled from Zahorik’s (1975) categories of planning decisions: 1) goals and lesson outcomes, 2) subject matter to be taught, 3) types of learning activities, 4) resources, 5) student readiness and prior learning, 6) how to assess learning, 7) teaching strategies, and 8) how to organization the teaching-learning environment (e.g., grouping, use of space, use of time).
Interviews

Interviews are beneficial for understanding what is not directly observable and to provide the opportunity for the researcher to inquire about background information, goals, and specific research agendas that may not be apparent in the classroom (Merriam, 2009; Yin, 2009). In this study, conducting classroom observations was not feasible due to the geographically diverse contexts of the participants; hence the interview was an important, if not the most important means of data collection.

Interviews were conducted online. Online interview times were scheduled through email. Three interviews per participant were conducted for this study for a total of 18. During the interviews, the researcher and the participant conversed via the use of a computer. Although all participants gave consent to be both audio and video recorded, one of the six participants preferred audio without video communication over the Internet; the other five participants communicated through both audio and video. Five of the participants preferred Skype for the interviews; one participant preferred Google Hangout.

The topic of the first interview was to discuss the participants’ TIA entry and the information collected in the survey (see Appendix E). The second interview centered on an upcoming lesson plan the participant has created for instruction. Participants were asked to send a lesson they were planning to teach in the near future through email. Once the researcher received the lesson, a time was scheduled for an online interview. The third interview involved on-the-spot planning activity given a particular standard in their respective content areas (see Appendix E). The following table indicates the date of each interview, time length, and communication method.
Table 3.

*Interview schedule, communication method, and time length*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Interview 1</th>
<th>L</th>
<th>Interview 2</th>
<th>L</th>
<th>Interview 3</th>
<th>L</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandon</td>
<td>09.12.13</td>
<td>48:23</td>
<td>10.02.13</td>
<td>29:50</td>
<td>11.06.13</td>
<td>52:30</td>
<td>Skype</td>
</tr>
<tr>
<td>Felicity</td>
<td>08.30.13</td>
<td>52:28</td>
<td>09.23.13</td>
<td>46:56</td>
<td>11.06.13</td>
<td>76:10</td>
<td>Skype</td>
</tr>
<tr>
<td>Ronan</td>
<td>09.04.13</td>
<td>53:47</td>
<td>09.24.13</td>
<td>48:00</td>
<td>11.04.13</td>
<td>43:30</td>
<td>Hangout</td>
</tr>
<tr>
<td>Laurie</td>
<td>09.04.13</td>
<td>30:01</td>
<td>10.23.13</td>
<td>25:25</td>
<td>11.05.13</td>
<td>37:12</td>
<td>Skype</td>
</tr>
<tr>
<td>Megan</td>
<td>09.18.13</td>
<td>30:19</td>
<td>10.08.13</td>
<td>47:01</td>
<td>11.05.13</td>
<td>63:45</td>
<td>Skype</td>
</tr>
</tbody>
</table>

Note: L = length of interview in minutes and seconds.

**Audiovisual materials and documents**

Audio-visual materials created as a result of the planning processes of expert technology integrating teachers enhanced the holistic account of the phenomenon being studied. All participants mentioned instructional materials they created to represent content using technology as well as student-generated products. When participant provided these artifacts, they were used to gain a better picture of aspects of teacher planning that surfaced during the interview process but were not transcribed and formally analyzed. For example, Felicity documented several of her lessons through instructional videos of her students for her students. These videos provided a window into her teaching environment that could not be conducted through observations.

Similar to interview data, artifacts also served as evidence of what the researcher could physically observe (1995; Yin, 2009). Because I did not have the opportunity to observe participants in their classroom environment, I requested documents related to their lesson planning. The documents included lesson plans, student handouts, and assignments. The documents collected were used to guide the focus of the second
interview. I asked participants questions about their written documents and probed them for more detailed explanations if their lesson plans were lacking in details. These documents were analyzed as one part of the overall representation of expert planning processes. Although planning research (e.g. John, 2006; McCutcheon, 1980) indicated that expert teachers rarely articulated lesson details in writing, it was important for me to see what teachers wrote versus how they talked about their lessons during the interview process. Lesson plans were emailed or I obtained them from participants’ instructional websites.

Data Analysis Procedures

This research study used qualitative content analysis (QCA) within the context of an case study to investigate complex units of study consisting of multiple variables with potential importance to understanding the phenomenon (Merriam, 1988). The teacher planning problem space provides the analytical framework for this study and how teachers negotiate this space is the unit of study. The following section is an overview of QCA and how it was used in this study to analyze data.

QCA evolved from its more quantitative counterpart, content analysis; originally defined by Berelson (1952) as “a research technique for the objective, systematic, and quantitative description of the manifest content of communication” (p. 18). As in almost all aspects of qualitative research, several definitions or orientations exist for QCA:

- an approach of empirical, methodological controlled analysis of texts within their context of communication, following content analytic rules and step by step models, without rash quantification (Mayring, 2004, p. 2),
- a research method for the subjective interpretation of the content of text data through the systematic classification process of coding
and identifying themes or patterns (Hsieh & Shannon, 2005, p. 1278), and

• a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use (Krippendorff, 2012, p. 24).

Krippendorff (2012) modified the requirements of Berelson’s (1952) original definition to be more inclusive of qualitative methods. By dropping quantitative from Berleson’s (1952) definition, Krippendorff (2012) acknowledged that these “methods have proven successful…in ethnographic research, in discourse analysis, and, oddly enough, in computer text analysis (p. 25).” Krippendorff (2012) excluded the word manifest in his definition because it implied that content was easily extracted and simply waiting to be described. Additionally, he changed the words objective and systematic to replicable and valid inferences and included a contextual requirement. With this change, Krippendorff’s definition of QCA slipped back in to emphasizing more quantitative methods. The words replicable and valid inferences implied that a goal should be to generalize. It was because of these words that I rejected Krippendorff’s (2012) definition and opted for Hsieh & Shannon’s (2005), definition because it provided the flexibility for interpretation but was also specific enough to provide a structure and emphasized the importance of context.

QCA is the most appropriate method for analyzing how expert technology-integrating teacher negotiate the teacher planning problem space because it is both contextually focused and flexible. Rooted in anthropology, sociology, and psychology, QCA was developed to explore meaning in communication by emphasizing the specific context of that text (Zhang & Wildemuth, 2009). The QCA method is flexible in that strategies for analysis encourage either 1) concept-driven approach, based on theory or
research, 2) data-driven approach, based on categories that emerge from the data, or 3) a combination of the two (Schreier, 2012). Zhang and Wildemuth (2009) go so far as to claim that QCA, if data-driven, can be used to generate theory. The following is a description of the data analysis procedures for this study.

**Informal Analysis and Data Management**

The analysis process was ongoing throughout the data collection period. Interviews of the first four participants were conducted between August 30 and September 4, 2013. The two remaining participants were unavailable for interviewing until September 12 and 18, 2013. The audio files were sent to a transcription service and returned within three days of each interview session. The first informal step in the analysis process was listening to the transcripts as I made corrections to them. The corrections I made included general typos or misspelling of teaching language and technology equipment that was unfamiliar to the transcription service. As I reviewed the transcripts, I also made mental notes of words or phrases that occurred and recurred across the four interviews. I sent a copy of each participant’s corrected transcript to participants to check for accuracy. Any additions, omissions, or corrections requested by the participants were then reflected in the final transcript for each interview. Once the participants determined the accuracy of the transcription, I began the analysis process.

To organize and manage the data, I used a computer-assisted qualitative data analysis software (CAQDAS) program called Dedoose. Dedoose is a web-based program for analyzing text, video, and spreadsheet data. Survey information, transcripts of interviews, and written lesson plans were uploaded and stored in a password-protected account.
Initial Coding

According to Schreir (2012), QCA methods tend to be more deductive and concept-driven to develop a set of categories early in the analysis process. I wanted to derive categories from the data inductively and began the analysis process with a data-driven process of open or initial coding. The first formal step in the analysis process was to perform initial coding methods to “fracture or split the data into individually coded segments” (Saldaña, 2009, p. 42). Although traditionally associated with grounded theory methods, initial coding was employed as a first step in order to remain open to the possibilities of what the data reveals (Charmaz, 2006). The data sample for initial coding consisted of the first four participant interviews conducted between August 30 and September 4, 2013: Felicity, Ronan, Henry, and Laurie. The remaining two first-round interviews of Brandon and Megan were not included in the initial coding process because of the time gap in scheduling their interviews. These interviews were conducted almost two weeks after the first four: September 12 and 18. The interviews of Felicity, Ronan, Henry, and Laurie were transcribed and uploaded into Dedoose approximately a week later. Within Dedoose, I created excerpts and performed open coding methods (Figure 9) to generate an initial set of twenty-four categories. During the open coding process, initial codes were applied to excerpts without a formal process, definition, or coding rules to allow for patterns to emerge.
After employing open coding on the first four interviews, I combined or omitted initial codes or created additional ones informed by literature and the conceptual framework, *teacher planning problem space*. This process was similar to what Schreier (2012) referred to as a concept-driven structure: strategies for coding in a deductive way to draw on theory and prior research to inform codes. For example, the code called *barriers/overcome barriers* was omitted after reviewing research related to expertise and technology integration (Ertmer, 1999; Ertmer et al., 2001; Ertmer & Hruskocy, 1999). This literature suggested that experts were not deterred from integrating technology into their instruction, but instead worked around barriers that typically halted their non-expert counterparts. The *barriers/overcome barriers* code was initially included because of familiarity with this literature. The aforementioned literature was concerned with
identifying characteristics of expertise, whereas in this study a population of experts had already been identified; hence the code for barriers/overcome barriers was outside the scope of this study and was omitted.

An example of modifying codes was the combination of the Time and Time Mgmt codes. This combination was not based so much on previous theory and literature as on redundancy.

An example of a code that was added involved the code identified as Routine, which was neglected in the initial coding process. According to the literature (e.g. Leinhardt et al., 1987), experts used routines to allow instruction to proceed fluidly and efficiently; hence routines were important to the way in which experts behave and were important in the planning process.

The process of combining, omitting, and adding codes transformed the initial codes into a working codes list (see Table F 1).

After determining a preliminary set of working codes, a codebook with formal definitions and coding rules was created. The working codebook was developed from Schreier’s (2012) method for defining the codes:

1. provide a description or definition of membership in the category,
2. list features or aspects of the data that typify the category,
3. specify indicators that demonstrate the presence of the category, and
4. include decision rules that indicate what is not included in a category (see Table F 2).

Because of the changes made to the initial codes it was necessary to recode the first four interviews. Originally the following excerpt was coded as Experience:
That’s what I would do. I would set up a place where I’d leave them all there and all they had to do was click and go find their picture and then we called it the “magic touch” where you save the image to your iPad (F., Interview 1, August 30, 2013).

During recoding, this excerpt was assigned the new code Routine.

**Document process**

Writing analytic memos to document the coding process and code choices is important to draw attention to potential subjectivity (Saldaña, 2009). Changes to existing codes were therefore documented in two ways: nesting notes within the working codebook, as well as creating separate memos in Dedoose. Table 4 is an example of a nested memo within the working codebook. Separate memos for coding decisions were also created using memo folders in Dedoose (see Figure 10).

<table>
<thead>
<tr>
<th>Code</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student experience</td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Participant mentions what the students experienced during a lesson.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Student motions: crying, excitement, panic. Talking about student products and student engagement.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Mentions the word “we” when describing a lesson – describes the lesson in terms of a shared experience (including the students or considering the student experience) and goes through the lesson with the students. The words: engagement.</td>
</tr>
<tr>
<td><strong>Decision Rule/Memo:</strong></td>
<td>This is different from describing a lesson or talking about a teaching strategy. (The NEGOTIATED LANGUAGE may become a separate code but for now, 9.28.13, it is a ROUTINE. (see Table F 2).</td>
</tr>
</tbody>
</table>
Figure 10. Coding memos in Dedoose. Yellow squares represent the coding memos in Dedoose; the number in the top right corner of each memo indicates that the memo was linked to a particular media file.

Tested coding frame

One important procedure of QCA is to test the coding frame for inter-coder reliability (Mayring, 2004; Schreier, 2012). To test the working coding frame, two transcripts were sent to a peer reviewer. All identifying information was removed from the transcript and replaced with a pseudonym. The peer reviewer was also provided a copy of the working coding frame. The coded transcripts from the peer reviewer were then analyzed for common coding schemes. If the coding of the peer reviewer and primary researcher did not match, the code was identified as unreliable. A code was considered reliable if the peer reviewer and the primary researcher’s excerpts were coded the same approximately 80% of the time. An untested code meant that the peer reviewer did not use the code in the test coding process. Table F 3 provided a summary of the codes that were reliable, unreliable or untested. As a result of the peer reviewer’s
feedback, the Working Coding Frame (see Table F 2) was revised and renamed the Tested Coding Frame (see Table F 4). The remaining fourteen interviews were coded using the tested coding frame.

**Provisional Coding**

The purpose of the first formal step, initial coding, was to recognize unanticipated codes as they emerged from the data. The purpose of provisional coding was to start with a set of categories to “grasp basic themes or issues in the data by absorbing them as a whole rather than analyzing them line by line” (Dey, 2003, p. 110). The rationale for recoding the data in this manner was to take a different approach to analysis and impose the structure of the analytic framework on the data for comparison and to create links to the open codes. The initial coding and provisional coding were compared to look for patterns. The 18 interviews were recoded according using six mutually exclusive codes: Curriculum, Learning Environment, Participant Profile, Planning, School Environment, and Reflection. These codes were generated from the conceptual framework described in Chapter 1.

**Gerund Coding**

Charmaz (2006) stressed using gerunds in coding to foster theoretical sensitivity because gerunds emphasize enacted processes. Because the main research objective of this study is to examine the planning process of expert technology-integrating experts, the participants’ descriptions of their intended actions are an important part of analysis. Starting with the provisional code called Planning, gerund coding was applied in search of patterns in the processes the experts used to design lessons. As needed to inform the planning process, gerund coding was applied to the remaining five codes.
Generate themes

After coding the data using three different methods (initial, provisional, and gerund), the individual codes and categories were compared within methods and across methods to look for evidence of connections between them. Saldaña (2011) referred to data intimacy as the process of taking cognitive ownership of data, during which the researcher gains “intimate familiarity with its contents and begin[s] to notice significant details as well as make new insights about their meanings” (p. 104). After coding and memoing, concepts were developed to move the data from concrete to abstract in an attempt to describe the planning processes of experts. In a process similar to the one for gerund coding, I created verb phrases for each of the 20 categories from the coding frame. For example teaching teachers was rephrased as compelled to teach teachers (see Table F 5). The verb phrases were collapsed into themes according to the conceptual framework resulting in two themes in the planning task environment and three themes in the planning problem space (see Chapter 5).

Credibility and Consistency

Because human beings are the primary instrument of data collection and analysis in qualitative research, interpretation of reality can be accessed through interviews and other sources of data (Merriam, 2009). Some researchers believe that reality can never truly be captured meaning that validity is relative and can never be proven (Maxwell, 2012; Merriam, 2009). Several strategies, however, can be employed to increase credibility: triangulation, member checking, reflexivity, and peer review. Addressed
briefly in other sections of this chapter, strategies for credibility and consistency were reiterated in this section.

**Triangulation.** Triangulation is strategy to increase credibility by using multiple methods “in an attempt to secure an in-depth understanding of a phenomenon” (Denzin & Lincoln, 2008, p. 7). Data was triangulated based on multiple interviews at different times over the course of a four-month period. The interviews were structured such that the first interview emphasized reflection, the second interview focused on a current plan, and the third highlighted a hypothetical planning scenario. The data was then coded using three different methods: initial coding, provisional coding, and gerund coding.

**Member checking.** Member checking is also a common strategy for increasing credibility (Merriam, 2009). I provided participants with copies of the transcripts of each of their three interviews for them contribute feedback to potential findings as well as to clear up misinterpretations.

**Reflexivity.** Reflexivity involves the process of critical reflection on one’s self as a researcher (Lincoln, Lynham, & Guba, 2011). I wrote memos and used peer-debriefing on the research process to note my subjectivity, dispositions, and assumptions regarding this research (Merriam, 2009). Lastly, I used a peer reviewer to read and comment on my findings.

**Peer review.** Lastly, I used a peer reviewer to read and comment on my analysis process as well as my findings. Traditionally, reliability refers to the extent the findings can be replicated which is especially problematic in studying teacher behavior (Merriam, 2009). Instead of using the word reliable, I prefer to use what Lincoln and Guba (1985) called dependability and consistency meaning that the results were consistent with the
data collected. I maintained consistency by creating an audit trail explaining how data were collected, categories were derived, and how decisions were made throughout the inquiry (Lincoln & Guba, 1985; Merriam, 2009).

**Ethical Considerations**

My goal as a researcher was to conduct an ethical study. The Institutional Review Board (IRB) at Georgia State University provided ethical oversight for this study, the purpose of which was documented in the initial email and consent form sent to participants. In the initial email, I informed potential participants of the requirements of the study and asked for consent. Because the study was conducted online, participants were additionally asked to consent to audio and video recording, audio or video recording, neither audio or video. Upon receiving consent, participants were contacted to schedule the first interview. During the first interview, I confirmed their consent to be recorded and reiterated the activities involved in the study. I made all efforts to maintain the anonymity of the participants through the use of pseudonyms. To date, however, thirty-two TIA winners are publically posted on the PBS website. Guaranteeing anonymity may therefore prove impossible; the participants were made aware of this. Data was stored in a password-protected file to which only the researcher will have access. Any hard copies of data were kept in a locked cabinet in the researcher’s office. Potential subjectivity that occurred during data analysis were reflected through analytic memos peer-debriefing.
Limitations and Delimitations

As with all methodologies and methods, especially in qualitative research there are limitations and delimitations.

Methodology

One common limitation of case study design is that the results are not generalizable. The point of this study, however, was not to generalize planning strategies of expert technology integrating teachers in a formal sense but to add to the collective process of knowledge accumulation through the experiences of individual teachers’ planning for technology integration (Flyvbjerg, 2006). Although the idiosyncratic nature of planning (John, 2006) and the complex, unpredictable, and ill-structured problem of teaching with technology (Koehler & Mishra, 2009; Mishra & Koehler, 2006) may never be generalizable, there is much to be learned from of individual instances of teacher planning for technology integration.

Case study delimitations are described in terms of bounding the context of the study. As previously mentioned this study was bounded by the experiences of TIA award winners while planning for technology-integrated instruction: what takes place in the empty classroom or during odd moments throughout the day. The act of teaching could not be observed and was therefore outside the scope of this study.

Methods

In addition to limitations and delimitations to the methodology, the methods also had limitations and delimitations.

Data collection. One limitation was in the method for data collection, which included participant responses via a survey and interviews. Limitations also existed for
the self-reported data because the data were susceptible to a certain degree of subjectivity (Archambault & Crippen, 2009). In this study, the data were limited to corroborating interview data because actual classroom observations were not feasible. Because there were multiple data sources, however, this limitation was not considered detrimental to the overall findings of the study. An additional limitation of data collection was the use of online communication to interact with participants. When direct interaction between researcher and participant occurred through online, technology therefore was more than a simple transactional medium (Salmons, 2011). The human qualities so important to interview communications were experienced differently; the technology limited the form of the communication in ways both subtle and obvious.

**Classroom observations.** The lack of classroom observations was a delimitation of the study. Because the focus of the study was on the planning events leading up to instruction, the study did not include the actual performance of teaching.

**Coding.** The combination of the using a CAQDAS (computer assisted qualitative data analysis software) program to code and the coding process itself was another limitation. Although coding excerpts using technology to organize data saves time, Dey (2003) states that in doing so the coded excerpts have arbitrary boundaries that lose the “unit of meaning” (p. 125), and by breaking up data, information about relationships between different parts of the data would be lost. Every effort was made to maintain not only the original context to make meaning from the data but also to examine the data in multiple ways. The data were first broken down into small pieces, then brought back together in broad codes or categories. In a separate iteration the transcripts with their
codes in context were analyzed and paraphrased to split and splice them with contextual meanings intact.

**Analysis.** The method of analysis also had limitations. Berleson (1952); Kracauer (1952), early proponents of QCA, suggested that conversations contain so many latent meanings that isolating the manifest content and describe it in such a way as to yield significant results would be difficult. Zhang & Wildemuth (2009, p. 312), however, stated that QCA “does not produce counts [frequencies] and statistical significance; instead, it uncovers patterns, themes, and categories important to a social reality.” To create a balance between description and interpretation, I presented quotes that were representative of typical behavior described by the participants (Schilling, 2006) as well as an illustrative and informed view based on creative data display (Miles & Huberman, 1994).

**Summary**

This chapter proposed a single case study to investigate the planning strategies expert teachers used in creating technology-integrated instruction. The sample for investigation included six participants who won an award for innovation in teaching. Data collected from interviews, audio-visual materials, and documents was facilitated through online communications such as email and video conferencing. The construct of the *teacher planning problem space* contributed to both the design of the study as well as the data analysis. Data analysis was ongoing throughout the collection process using QCA methods. The chapter also addressed issues related to credibility, consistency, ethics, limitations, and delimitations.
CHAPTER 4
RESULTS

The purpose of this study was to describe the planning strategies that expert teachers use in designing technology-integrated instruction. Using the teacher planning problem space model, the main research objective that focused the study was: How do expert teachers plan for technology-integrated instruction? The sub-questions were:

1. How do expert teachers negotiate the planning task environment?
2. How do expert teachers negotiate the planning problem space?

The sections in this chapter are organized according to the participants and are presented in alphabetical order. In each participant section, there are three subsections: participant background, planning task environment, planning problem space. The first subsection provides more detailed background information of each participant. The second subsection addresses research objective one, the planning task environment of each participant, which included school setting and classroom circumstances in the participants’ environment around which they planned as well as curriculum expectations and resources. For the six participants’ planning task environments, the curriculum is presented as part of the school environment because the nature and type of school dictated in part the type of curriculum offered.

The third subsection represents the mental space in which teachers plan and addressed second research objective. The teachers’ mental space for planning consists of a problem statement, or how these teachers interpreted their curriculum to present it to students. After developing a problem statement, teachers entered a design space in which they drew from knowledge and experience to search for solutions to an instructional
problem. The first step in searching for a solution within the design space was creating activity structures and implementing classroom routines. The second step was developing a solution path. The solution path led to a goal state, which was a mental or written plan that was ready to present to students.

**Brandon**

**Collaborator.**

Brandon served as an instructional technology specialist at a middle school in the rural Southeast. He had taught for sixteen years: six in his current position, eight of which were as a middle school Language Arts teacher, and two years teaching English Learners of Other Languages (ESOL). At age 48, he held two Master’s degrees, one in Instructional Technology and one in Educational Media. In addition to his teaching certification, he was certified to teach gifted students and served as a coordinator at a previous school. Additionally, Brandon drew from his skills as an Instructional Technology Specialist to collaboratively plan a lesson for which he won the Teacher Innovation Award. Brandon’s motivation for applying for the award revealed his competitive side: “I wanted to win that contest. That was my goal” (B., Interview 1, September 12, 2013).

Brandon described his adoption of technology as relatively sparse in the beginning of his teaching career. Toward the end of his ten years in the classroom, he used technology more because:

Number one, it is an engager of students. It heightens student engagement in whatever lesson that I’m doing. I was able to use technology to motivate certain students to perform at a higher level. And I saw that the use of technology often resulted in because of higher student engagement,
better student outcomes. So I started out using basically a laptop and a
projector onto a white screen that I would pull down (B., Interview 1,
September 12, 2013).

When Brandon was a classroom teacher, he said technology was especially useful for
“front-loading information” (B., Interview 1, September 12, 2013). He would:

Pull in video, music, sound and stuff like that in order to get this
background knowledge in terms of concepts. Of course I’m speaking
about Language Arts. Social Studies would be different and Science also,
needs a lot of that. So I would just make a list, just brainstorm things, a
way to bring this in [to instruction] and with students, you have to keep it
moving… (B., Interview 1, September 12, 2013).

As an instructional technology specialist, his “… key role was to meet with
teachers either as grade-level to do professional development or in small groups/teams or
individual teachers to help plan specific activities and lessons that incorporate technology”
(B., Interview 1, September 12, 2013). In this role, he said, “I have to be really flexible
and let the teacher kind of say what it is that they want… I have a reputation for being
very adaptable” (B., Interview 1, September 12, 2013). Sometimes teachers requested
assistance with understanding the affordances of a particular technology tool:

Last week a teacher… wanted to use Glogster which is an interactive
poster that the students can make using their laptops. She said to me, “Hey.
I want to use this.” So I went to my account and I sent her a couple of
examples of what I had done and sent it back to her and said, “Okay.
These are examples of what can happen.” Then I went to her classroom
during her planning time, we got on the computer…both of us were on her
computer and she was working at learning at how to use the tools. (B.,
Interview 1, September 12, 2013)

On other occasions, Brandon met with teachers who had a specific content need:

…like in Social Studies, eighth grade teachers…said, “Hey. This is
what’s coming up in a couple of weeks”. So there’s [our state] and World
War II or the area or the time right before. I got online and I went to the
museums of [our state], [to] learn and see different resources and just pulled a bunch of links to stuff, saving them kind-of the legwork of looking through it and just finding them the stuff and saying, “Okay. Look through this. Which direction would you like to go in? And what would you like to do?” We’ve done some pretty interesting stuff. (B., Interview 1, September 12, 2013)

Although some teachers were interested in a particular tool, Brandon observed that teachers usually found a balance between the content and technology tools. He said:

… many of the best teachers use [technology] balanced. They will have a little bit of direct instruction and then some group activities and then at some point, of course most of them when they’re doing their direct instruction, they’re using the SmartBoard with visuals, with video, sound and then there will be some type of group activity where most of the students, they’re up and moving, talking, sometimes they’re even out of the classroom. They’re doing things like a gallery walk or something like that and then if it’s necessary, the technology for the student, I’m talking about the laptop, will be used. Last year some students created a website and it was kind of like a digital repository for the work that they did throughout the year.

Whatever the needs of the teacher, Brandon stated “… a lot of our teachers would be hard-pressed to go back to not using technology because once they’ve used it, …there is so much information and it’s so easy to find out stuff and share things through technology” (B., Interview 1, September 12, 2013).

**Brandon’s Planning Task Environment**

**The school environment.** Brandon’s middle school had approximately 625 students in grades 6 – 8 and is part of a small city public school system. It was free to attend Brandon’s school if students lived within the city limits and the school offered a traditional curriculum driven by Common Core State Standards. Brandon’s curriculum was guided by a combination of teachers’ needs and a set of technology standards for
teachers. As mentioned in Chapter 1, one ISTE standard required that teachers create a technology-rich environment for learning. Brandon used these standards to develop teachers’ knowledge of technology in teaching and learning to foster creativity and create authentic learning experiences.

Teachers in Brandon’s school taught four academic periods lasting 50 minutes and had 2 hours for planning scheduled during the school day. His daily schedule was different from a classroom teacher schedule. Although he had the flexibility to create his own schedule, it was “pretty routine nonetheless” (B., Interview 3, November 6, 2013). He arrived at school around 7:45am each morning to work on the morning announcements. The announcements were presented through closed circuit television as a slideshow including information such as “student news, announcements, lunch menu, word-of-the-day, sports schedules, our weather quality flag” (B., Interview 3, November 6, 2013) and school events. The rest of his day was dedicated to:

… something to do with laptops. It is a steady stream of people with problems; can’t get on, can’t log on, broken screen. But I still find time to go into the classrooms to talk with teachers. We have regular meetings. They have their team meetings and I attend some of those. We have weekly collaborative conversations on Thursdays where it’s groups or whole grade levels and other administrators and specialists and we all meet together. (B., Interview 3, November 6, 2013)

Although his day was busy with assisting teachers, he made time to work on gathering resources and creating lessons for teachers.

Brandon described the overall culture of his school as one in which teachers were not “afraid if something doesn’t work right” (B., Interview 1, September 12, 2013). Additionally, he believed that he had contributed to the “adapt and overcome” culture in his school because he had the autonomy to define and establish his role in the school,
create a network of teachers who gravitate to using technology as an educational tool, and usher in several new technology initiatives.

**The teaching environment.** Brandon’s learning environment alternated between an audience of students and one of teachers. According to him, the biggest issues students encountered were “that they can’t remember their password for some account or something” (B., Interview 2, October 2, 2013). For teachers, Brandon noticed “a gap between interest in using [technology] and interest in learning how to make things” (B., Interview 2, October 2, 2013). According to Brandon, one reason teachers did not integrate technology was:

… that they’re really pressed for time and it takes time to sit down and really create something. But I’ve told them that once you create it, I mean, you have it. You go back to it or you modify it in the future. (B., Interview 2, October 2, 2013)

To address this gap he created resources for teachers and helped them locate resources to scaffold the learning process. Additionally, he offered to “co-teach the first time and then let [the teachers] do it. Just to show them the things but it’s very simple. It’s not very complicated” (B., Interview 2, October 2, 2013). By his presence in the teachers’ classroom, they “probably feel a little bit better” about integrating technology (B., Interview 2, October 2, 2013).

Because of his role, Brandon did not have his own classroom; instead he tended to assist teachers in their classroom or conduct lessons with students and teachers in media center. For example:

I went to a classroom… and I hung out [for] a lesson because I made some resources for the teacher. It was cool to see the stuff that [I] made; seeing how students were reacting to it or working with it. [After that,] I came
back down to the media center for the next group of 6th graders. (B., Interview 3, November 6, 2013)

In the media center, he was also assisting an art teacher with a sixth grade lesson on Indian film. He said:

I should be in the media center helping them out but we’ve done it twice all day or twice already… My philosophy is if the teacher has already seen it done it twice, by the third time they should be jumping in… (B., Interview 3, November 6, 2013)

Another use for the media center was to coordinate the distribution of school laptops for students. At the beginning of each school year, students at Brandon’s school were either issued or re-issued a laptop. For new students:

… they come to the Media center, we do an orientation… One purpose was to introduce the laptop and little things about it; how to carry it, how to put it in the case, Internet safety type things, digital citizenship types of things. (B., Interview 1, September 12, 2013)

What he called his office was not actually an office but a teacher workroom where he created his own workspace when he was not working with teachers:

…it’s the copy room and the printer room… it’s not an office…there were some shelves and this kidney shaped table that was left over and this chair I snagged. So it kind of gave the idea that there was potential [for an office]. (B., Interview 3, November 6, 2013)

**Resources.** Because of his role as an instructional technology specialist, Brandon was also a human resource for teachers in his school: locating technology tools for teachers to use in their instruction. Of the resources available (see Table 5) to teachers at Brandon’s school, he gravitated toward using a combination of the interactive whiteboard and Web 2.0 tools. Web 2.0 tools are online programs generally categorized by the
services and applications they provide including blogs, wikis, multi-media sharing services, content syndication, podcasting, and content tagging services. Some tools Brandon used were Screencast-O-Matic, Glogster, Corkboard, Socrative, Google Apps, and Edmodo. Screencast-O-Matic provided a way for students to demonstrate knowledge by capturing their explanations in screen recordings. Glogster allowed students to create an interactive poster to display their understanding of a particular concept. On Corkboard, students and teachers could share ideas and comment on each other’s ideas.

In reference to data collection, Brandon said, “We have a lot of common type assessments” (B., Interview 2, October 2, 2013). Socrative was an online tool to help teachers facilitate the administration of assessment as well as grade them. Google Apps and Edmodo both served to organize, manage, and provided access to content.

Table 5
Survey results of Brandon’s technology resources and frequency of use

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Available</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Computers located in your classroom everyday</td>
<td>26 – 30</td>
<td>Often</td>
</tr>
<tr>
<td>Computers that can be brought into your classroom (e.g., laptops on carts)</td>
<td>26 – 30</td>
<td>Never</td>
</tr>
<tr>
<td>Computers in the computer lab</td>
<td>26 – 30</td>
<td>Never</td>
</tr>
<tr>
<td>LCD or DLP projector:</td>
<td>Yes</td>
<td>Never</td>
</tr>
<tr>
<td>Video conference unit</td>
<td>Yes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Interactive whiteboard (e.g., SMART Board, Activboard)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Classroom response system</td>
<td>Yes</td>
<td>Never</td>
</tr>
<tr>
<td>Digital camera (still or video)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>MP3 player/iPod</td>
<td>No</td>
<td>Never</td>
</tr>
<tr>
<td>Document camera</td>
<td>Yes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Handheld device (e.g., iPad, iPod, Windows Surface, other tablet)</td>
<td>Yes</td>
<td>Rarely</td>
</tr>
</tbody>
</table>
To find new resources, Brandon maintained that he was, “pretty much open to what’s happening” (B., Interview 3, November 6, 2013). He subscribed to sites that sent him notifications of new resources that could be useful in the classroom. He said most of the resources he found were because he was “paying attention to what’s going on,” and “if I’m looking for a certain topic for a teacher, I mean invariably I’m coming across other things” (B., Interview 3, November 6, 2013).

Brandon’s Planning Problem Space

**Problem statement.** Brandon mainly collaborated with other content areas. While he served all content areas, he believed that, “Social Studies and Language Arts seems to lend, those areas of curriculum seem, to lend themselves to technology integration easier than others” (B., Interview 1, September 12, 2013) and he was able do more interesting content planning in those areas. To assist teachers at his school he was:

… able to go to these teachers, observe their classroom, make suggestions, co-teach or show them how it can be done. They have four classes so usually this is the way it goes: In the beginning, the first class, I’ll do it; and the second class we’ll do it with me taking the lead; and the third class we’ll do it with them taking the lead; and the fourth class, they’ll do it. And then they can handle it (B., Interview 1, September 12, 2013).

Brandon, like Ronan specifically mentioned creating his own content for students:

I always thought [in Language Arts] it was better to come up with your own questions… like really deep thinking type of questions. Some of my best work I got out of students was like, “Okay. Answer this question in a poem with the structure abab”. (B., Interview 3, November 6, 2013)
Design space: Activity structure and routines. Brandon referred to changing *the channels* as creating different activities to cater to different learning styles such as auditory, visual, and kinesthetic. To address those learning styles, he designed activities:

[W]here they’re writing something, where they’re reading something, where they’re speaking, where they’re listening, where they’re moving, they’re getting up and going to different corners of the classroom, they’re sitting down. I mean, you know before you know it, it’s time to go to the next class so that was the key in a way (B., Interview 1, September 12, 2013).

He tended to start lessons with an introductory component in which students were first exposed to new content. This was followed by a “research component where the students find out more, identify gaps in their own understanding,” using a graphic organizer or interactive notebook (B., Interview 2, October 2, 2013). Finally there was an assessment piece which could be done several ways but one mentioned by Brandon was using *Screencast-O-Matic*, an application he described as simple to use:

basically just hit ‘Record’, it gives you a brief two, one countdown and then it just records everything on your laptop screen. So [students] can click through their images and then just speak…(B., Interview 2, October 2, 2013)

In working with teachers, during the research component, Brandon would sometimes structure activities in Language Arts by grouping strategies:

… give [students] something to read and have… a [corresponding] question for each one and have them present… we give a whole group thing, talk it out with everybody and then we kind of break them up into little groups and they all have their little separate jobs. And then there’s something they’re able to present, either to their [small] group or to the whole group, [to] present the findings of their group. You know, it’s kind of like this routine where it’s everybody in a small group, individuals are working, contributing to the group and then they give back to the whole group at the end… (B., Interview 3, November 6, 2013)
Brandon said he changed the channels every 10 – 15 minutes, but was flexible depending on the students:

I know it would be somewhat longer if necessary or shorter but it would be pretty much segmented. We got into a kind of a rhythm too, a routine, a certain…we do certain things first and then it would be something else. So although it was varied, it was also scheduled and familiar…(B., Interview 1, September 12, 2013)

**Design space: Solution path.** Planning for technology integration was important to Brandon. He stated that:

I like to have a plan and I learned when I was a classroom teacher to have a lot of stuff planned, more than you’ll need and but also to be flexible if something is not working or if something is really working, to disregard the schedules and keep with it or move to change it if necessary” (B., Interview 1, September 12, 2013).

Flexibility was especially important when technology was involved in a lesson because, “there’s going to be problems or there will be something, and I think it’s a skill that students need to know: [that they should] not get hung up on something [but to]…find a different way, find a way to deal with the problem” (B., Interview 1, September 12, 2013).

He described his planning as backward design with the end in mind. He asked questions of teachers to prompt them to think as they collaborate:

What is it that you want to be happening at the end? What are the materials that you’re going to be using, your print resources? … [T]hen we just kind of work together. We just kind of brainstorm and if I have a suggestion or say, “Have you thought about doing something like this?” (B., Interview 1, September 12, 2013).

**Goal state.** In reference to written lesson plans, when Brandon was a classroom teacher he said, “If they were really good I would write them down. Of course if I had a requirement to keep my lesson plans, then I would write it out” (B., Interview 1,
September 12, 2013). Most of the time, however, he would not write up a formal plan if he was teaching the lesson. He “would just have key words to remind me of what it was I wanted to do” (B., Interview 1, September 12, 2013). When he was collaborating with teachers, because he was in the room during the instruction, he also did not write out formal plans unless teachers’ requested it.

**Brandon’s teacher planning problem space.** Brandon’s middle school followed a traditional curriculum that was guided by the Common Core State Standards and the ISTE Standards for teachers (see Figure 11). He taught at a public school with a one-to-one laptop initiative and did not have a regular schedule as classroom teachers did. Instead he created his own schedule to serve teachers’ needs. Brandon preferred to use Internet-based tools when integrating technology into instruction. His problem statement tended to be technology-oriented because of his role as an instructional technology specialist and he planned collaboratively for or with teachers. Drawing from his knowledge and experience, Brandon created a flexible structure of activities and routines. He described a typical lesson as having three parts: introduction, research phase, and assessment piece. His routines were embedded into the activities and emphasized grouping strategies. His solution path was either content or technology focused depending on teachers’ request and included characteristics such as flexibility and troubleshooting. Creation was also important to Brandon. His goal state was either written or mental.
Felicity

Artist

At 44, Felicity had taught for twenty-one years and currently taught art at a relatively small elementary school in the suburban Midwest. She held a Master’s degree and had taught in her school district for over nine years. During her career she had published articles, conducted professional development and won several awards. Recently she was asked to participate in research project for innovation in education and on a panel discussion on art in education. Her motivation for applying for the Teacher Innovator Award was to acquire more resources for her students.

One thing that was important to Felicity was sharing her ideas and resources with other teachers. According to Felicity, she wanted “other people to have access to that information so they could share, do it with their students too” (F., Interview 3, November 6, 2013). She posted all her students’ finished artwork in a digital format to serve two
purposes: “I’ve showcased it and it also became a resource that I could share with other teachers that want to try this” (F., Interview 1, August 30, 2013). Some of her work was shared with other art teachers who in turn shared “it with their staff [to] have a Professional Development around it…” (F., Interview 2, September 23, 2013)

**Felicity’s Planning Task Environment**

**The school environment.** Felicity’s school was a small public elementary school in the suburban Midwest. Her school had a little over 500 students, and all attended Art class with Felicity. It was free to attend Felicity’s school if students lived within a zone designated by the school district and the school offered a traditional curriculum driven by Common Core State Standards.

Her course was considered what elementary schools call *Specials*, which also included Music, Physical Education, and Library/Media Center time. *Specials* were not a part of the core curriculum; hence students only attended her Art class once a week.

Although Felicity used State standards to determine the core concepts she needed to teach, she emphasized the “freedom” (F., Interview 2, September 23, 2013) she had in the way she taught the content. Students in her school did not receive grades for their work in her class:

4th and 5th graders get a symbol of whether or not they’re completing their work and if their behavior is good and if they’re exploring concepts. …And then the kindergarten through 3rd grade don’t get any kind of symbol or anything on their report card. (F., Interview 3, November 6, 2013)

Instead of grades, Felicity posted students’ work on an online art gallery for families and friends to see. Her enthusiasm teaching her curriculum was evident:
I think it all goes back to how is it going to enhance the learning for your students. I get excited about the idea of bringing in something fresh and exciting and relevant to my students. When I’m excited about an idea, it’s energizing my students, they are excited about it, the idea, everybody is motivated and things are flowing really well. It’s never an issue about motivation. We’re always very excited about the learning that happens in this room because this is the medium, you know, art. It’s exciting. (F., Interview 1, August 30, 2013).

Felicity said her students’ work was “just awesome, so much so that we need an authentic audience to share it… that’s why I’m making movies and getting them out there on the website and entered into contests” (F., Interview 1, August 30, 2013).

Kindergarten was scheduled as a 30-minute class period and grades 1 – 5 were 45-minute periods. Her first class began at 9:10 am. Felicity’s schedule was different depending on the day. On Mondays and Wednesday, Felicity had two 45-minute planning periods and on Tuesday she had one. Her most challenging days were Thursdays and Fridays because she taught six classes back-to-back with no planning periods: “I have a 4th grade, then I have two 3rd graders, 3rd grade classes back-to-back…then after lunch, I have two kindergarten classes back-to-back and then I end with a 4th grade class” (F., Interview 3, November 6, 2013). During the days with no planning:

So that’s a busy day; six classes. The grade levels that are the same are back-to-back, so that helps and every time there’s a grade level change, there’s 15 minutes so that’s not planning time for me…that is tearing down the set-up and switching out the digital files and getting everything physically ready for when the next group comes in, in those moments between classes…There’s no time to get anything done…So I have to just think about using my time as wisely as I can Monday, Tuesday and Wednesday because Thursday and Friday is just crazy (F., Interview 3, Nov. 6, 2013).
Felicity’s classes were subject to being cancelled without much, or any notice. For example, her second grade students were going to start their Halloween painting project but “because they have a rehearsal for their musical, so Art is cancelled for them” (F., Interview 3, November 6, 2013). As a result, “…it’s going to be well after Halloween before we can start our ghosts…but that, I can’t help it but it’s going to be fine. They’ll be excited to do it” (F., Interview 3, November 6, 2013).

Felicity preferred to plan at school, but because it is difficult to get planning done during the school day, she got to school between 7:15 – 7:30am. She was “one of the earliest ones here just because it’s quiet in the morning; I can think” (F., Interview 3, Nov. 6, 2013). During that time she thought through her plans and made “any last minute adjustments before…the kids show up” (F., Interview 3, Nov. 6, 2013). Students were dismissed at 3:35pm and teachers were allowed to leave at 4:00pm. Felicity also used the afternoon to prepare for classes, photograph student artwork, digitally label it, upload it to an online art gallery, and putting images into students’ individual digital portfolios. “I’m here [at school] until whenever I’m at a good stopping point, which sometimes is closer to 5:00 pm or 5:15 pm” (F., Interview 3, November 6, 2013).

In addition to her teaching responsibilities, Felicity conducted professional development for her school district, other districts in her state, and neighboring states. This past year she led several workshops about creating art using iPads. She facilitated her instruction from a website that housed a “template that we could all try to practice with then the template is there and I teach [other educators] from this website” (F., Interview 1, August 30, 2013). Referencing the website, she said:

I do my workshops from here where we can go through all these different kinds of techniques and try different things and usually these ideas would
work with people from any curricular background because they’re open-ended or some of the ideas are mostly about sharing techniques. (F., Interview 1, August 30, 2013).

**The teaching environment.** Felicity’s average class size was 24 and she was the only Art teacher in her school. Her classroom, like each of her lessons was filled with lots of things with which to interact. Imagine standing in the middle of Felicity’s room and turning as she described her classroom:

… it’s really busy. It’s full of fun stuff to look at and lots of like really silly things; like I have a… plush toy bacon and you squeeze it and it says, “I’m bacon” and the kids think that’s funny… I have a huge cardboard cut-out of *The Screamer* from Edvard Munch’s *The Scream*. We dressed it up. He’s got a hat and a fake nose on… the furniture doesn’t really match… the tables are what ever was, somebody was throwing out; I grabbed them. All of the storage units are like that. They’re old, they’re broken and I’m holding them together with contact paper and duct tape… I [also] have a Mrs. Felicity-Clone. (F., Interview 3, November 6, 2013)

Mrs. Felicity-Clone was a classroom management tool:

I made a life-sized version of myself out of cardboard… It’s in different places [in the classroom] every year but her name is Mrs Felicity-Clone and I tell the kids that she’s always watching and she reports back to me on how they behaved. There’s a song for her too. It’s to the tune of *Santa Claus is Coming to Town*. (F., Interview 3, November 6, 2013)

Felicity extended her learning outside of the allotted class time. She said:

Sometimes we have a lunchtime, sort of like a club but it’s per project so it’s not like a year long club, it’s a movie making group and [students] work with me until the movie is done and then maybe a new group comes and makes another movie. (F., Interview 1, August 30, 2013).

The idea behind the movies Felicity and her students made was “that the kids make teaching resources that we use to teach other students” (F., Interview 1, August 30, 2013).
Table 6
Survey results of Felicity’s technology resources and frequency of use

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Available</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Computers located in your classroom everyday</td>
<td>1-5</td>
<td>Often</td>
</tr>
<tr>
<td>Computers that can be brought into your classroom (e.g., laptops on carts)</td>
<td>26 – 30</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Computers in the computer lab</td>
<td>26 – 30</td>
<td>Rarely</td>
</tr>
<tr>
<td>LCD or DLP projector:</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Video conference unit</td>
<td>Yes</td>
<td>Rarely</td>
</tr>
<tr>
<td>Interactive whiteboard (e.g., SMART Board, Activboard)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Classroom response system</td>
<td>Yes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Digital camera (still or video)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>MP3 player/iPod</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Document camera</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Handheld device (e.g., iPad, iPod, Windows Surface, other tablet)</td>
<td>Yes</td>
<td>Often</td>
</tr>
</tbody>
</table>

Resources. Felicity has several resources available: some provided by her school, but several were either won through entering contests or solicited online from her website (see Table 6). Additionally she had parent volunteers who helped in her classroom:

I try to recruit as many parent volunteers as I can for the physical parts. They like to help get the artwork in the hallway [and]… can sometimes do some prep for materials. (F., Interview 3, November 6, 2013)

In her art classes she used technology resources in many ways. To design and facilitate her lessons she used Keynote, presentation software created by Apple. She said:
I went to a workshop to learn Keynote. I didn’t know what it had to offer but once I played with it, I thought, “Oh. I can see uses for this” and then the ideas started to flow in for how to make this work in my classroom and why that would be good in my classroom. (F., Interview 1, August 30, 2013)

She also had several years experience with another Apple product: iPads. She described an early experience with using iPads with her Kindergarten students:

...four years ago, it was the first time [Kindergarteners were] touching an iPad and it was different and unexpected and they didn’t know how to pinch or zoom or anything and all of sudden everything went away when they hit that button. Everything was like terribly disturbing and upsetting to them and they would cry, they didn’t get [how to use it] and their hands were in the air “I don’t get it!” and you know, panic. But it’s not like that anymore. (F., Interview 1, August 30, 2013)

Another important resource for teaching was Felicity’s document camera and interactive whiteboard. The document camera and interactive whiteboard were useful for demonstrating presenting processes: “I put my tray under the USB document camera, and I demonstrate the color mixing while they’re trying it at their seat” (F., Interview 2, September 23, 2013). The whiteboard allowed for students to:

…do a digital Jackson Pollock collaboration on the interactive board. So there’s a website where you touch the screen, it makes a splash of paint and so everybody gets a chance to come to the board and touch [it] and give it a splash of digital paint. And it becomes [a] collaboration, abstract piece that’s similar to what we just did in our paint tray. (F., Interview 2, September 23, 2013).

Felicity used a variety of iPad applications as well as a green screen. The green screen provided her and her students a way to “erase the background of a photo and then layer it in a graphic design” (F., Interview 1, August 30, 2013). She said of the technology available: “the sky is the limit when we’ve got green screens and iPads and all these cool things” (F., Interview 1, August 30, 2013).
Felicity’s Planning Problem Space

Problem statement. Felicity was “struggling with the debate that’s going on right now in the art world about this open-endedness for creativity versus structure that covers concepts” (F., Interview 1, August 30, 2013). She felt that:

… what makes more sense with my elementary students is to give them enough structure so they are…so that I’m sure that they’re learning the content that I need to deliver with enough open-endedness within the same project where they feel like they can express themselves or transfer their own knowledge or do some problem solving or show their creativity. I want both [structure and open-endedness] but just the idea of being too open-ended where I say, “Here is my art room. Go at it”. I understand that that would be really great for some kids, but just confusing [for others]. So many would be lost and just making rainbows and stick people. I just need a better balance than that. (F., Interview 1, August 30, 2013)

She created a balance by designing projects that have a structured part, but then an open-ended, problem-solving part that allows for creativity and “transfer their knowledge” (F., Interview 1, August 30, 2013). An example she gave was a second grade project on portraits of George Washington which “was very structured because we were all drawing George Washington, so I was helping them through all the steps, you know, giving them suggestions about how to draw all the features, the size, and placement, etcetera” (F., Interview 1, August 30, 2013). The open-ended part involved broadening the lesson to include Social Studies content. During the lesson students watched and listened to facts about George Washington. The students then got to choose what they felt was important about the president to share in their video clip posing as George Washington.

Felicity remembered when she was first hired several years ago, she used a team teaching approach with core classroom teachers in which they would bring their
curriculum into the art room and teach the content together (F., Interview 3, November 6, 2013). For example:

As we were making paper mâché whales, [the core teachers] were reminding their students about all the facts that they had learned about whales. And they were bringing in their resources about whales and while I was bringing in my expertise on sculpture. (F., Interview 3, November 6, 2013)

But now the curriculum for core teachers was dictated by State standards so this kind of collaboration does not occur anymore.

Felicity used technology to facilitate her teaching as well as for her students to create art. She said:

We’ll make [the art] digitally first and [I’ll] let them play with it, let them understand overlapping foreground, middle ground and background by digitally putting the shapes together as a class and talking about it. And then [we use the same concepts] physically in [their] artwork. (F., Interview 1, August 30, 2013)

With Felicity’s curriculum, technology was

… fitting all the time for instruction. It’s not fitting all the time for art production. So like when the kids are making their [landscape paintings], they didn’t use any technology to do it but I was using technology to teach them how to do it. [Students] will do some technology when they do the [ghost animation over their landscape paintings], so that will be an extension. (F., Interview 3, November 6, 2013)

She felt that a technology tool was more powerful when it was used for creation. Felicity reflected on when iPads were first introduced in her school, teachers:

… started downloading crazy apps. And it meant that we were just going to teach whatever the app teaches and that was like, well that wasn’t even really what I wanted. The iPad became something extra to do if you have extra time. You know, go play with the app. That’s a little bit of a reinforcement, sort of what I wanted but…that frustrated me [because]
that I knew that playing apps wasn’t my curriculum. (F., Interview 1, August 30, 2013)

Her frustration prompted her to find what she called creation apps:

I don’t know if playing apps was really going to bring more learning and enhance our learning experience in the art room. So then I found creation apps where, I found Sketchbook Express, a very simple app but it had a very powerful feature. You can use layers. (F., Interview 1, August 30, 2013)

These kinds of applications transformed her instruction. The applications were simple to use so that Felicity “didn’t have to teach them how to use that app anymore” (F., Interview 1, August 30, 2013). Her instruction:

…was all about learning the art concept and I was less of the technology teacher and more of the art teacher…. I was actually teaching creation. We were making art but doing it digitally and learning some new concepts that we weren’t able to do otherwise [without technology] and that started to enhance my program. (F., Interview 1, August 30, 2013)

**Design space: Activity structures and routines.** Felicity had numerous routines that helped her complete several activities in a short amount of time. A typical class tended to have at least three main activities lasting about ten minutes each. Her activities for her youngest students needed a of change activities often because they had a limited attention span:

I only see them for 30 minutes but we have to have a lot of activities and switches in that 30 minutes to keep them going… And as soon as I lose them, it’s another 3 to 4 minutes to get them back. (F., Interview 2, September 23, 2013)

The art projects in Felicity’s class tended to last at least three class sessions. A typical first session was an introduction to the project and a chance for students to explore the concepts associated with the project digitally. The second class was
dedicated to creating a work of art and the third class was for craftsmanship and
displaying art. During the introduction session students participated in approximately
three activities: digital, physical, and digital. For example: “The first day is an
introduction to ‘What Are the Primary Colors?’ and so we do a digital color mixing
project where, and they do a physical color mixing project and we play a color, color
wheel game” (F., Interview 2, September 23, 2013). During digital color mixing activity,
students came to the interactive whiteboard and used the highlighter tool to color in
spaces on a hexagonal shape to represent the primary and secondary colors. When
students used the highlighter tool to draw over primary color, the color changed to a
secondary color. For the second activity, students had a handout of the same hexagonal
shape and used crayons to color in the appropriate spaces: “We build a game of the color
wheel together at our tables and I do it digitally on my interactive board at the same time”
(F., Interview 2, September 23, 2013). The third activity was an Internet game where
student could sort, mix, and paint with primary and secondary colors.

Felicity used routines for classroom management as well as for saving time. She
began class with a management routine:

There’s the way I start class, where everybody has to show me that they’re
Monificent. …the Mona Lisa is a good example of a good listener. Her
eyes are on you, her mouth is quiet and her hands are still. So I say
“Mona” and [the students] say “Lisa” and they turn their body into the
Mona Lisa…so that I know that they’re ready to listen to directions. (F.,
Interview 3, November 6, 2013)

Another management routine was for cleaning up after creating artwork:

…it’s like a little interactive slide that I put up [on the board] where I drag
and drop the items next to a chair number. So I have a one, two, three,
four and then I grab the [images of] paintbrushes and stick it next to one or
grab the paper towel icon and stick it next to two and so I make a little
visual for the kids on the slide of what their jobs are, I quickly explain it
and then I start the music that’s on the slide, which is Footloose. I also have a finish line there too with all their table numbers. There’s six tables so we pay attention to which table has cleaned up and back in their seats first and those that cross the finish line get set up in order and then I might decide to call those tables first to line up. (F., Interview 3, November 6, 2013)

Felicity also used instructional videos introduce art terms, remind students about craftsmanship, and learn about techniques. Several of the videos involved students, so younger students recognized older students in the videos. The “Stay Neat” video is a rap made by second grade students: “Dip Your Tip, Do Not Drip, Hold Your Brush with a Pencil Grip, Stay Neat in Your Seat, Good Artwork Can’t Be Beat!” (F., Interview 1, August 30, 2013). “Black Marker” is a video “that we pull out at the end when we’re ready to do our ‘black marker’ step. Black Marker is an Art Room superhero and it brings back all the details that were lost with the sloppy paint” (F., Interview 3, November 6, 2013).

Other routines were about physical locations for class activities. When students talked about creating artist statements for their artwork, Felicity had her youngest students “huddled on the floor and cozy and comfortable” because she noticed that they’re not comfortable shouting out an original title from across the room to me” (F., Interview 1, August 30, 2013). From this position seated on the floor, she felt:

…it just seemed easier [for students] to take a risk… I just think about what safety feels like. It’s not safe to shout out an original thought from across the room like “I think my painting looks like scrambled eggs!” That’s only the really confident kid who can do that. [Then there’s] one that says “It’s a rainbow butterfly” but they can only whisper it. You know that person needed to be in a small group for that and then for me to say “That is an amazing title! I can see the rainbow butterfly!”… or whatever and then we all can nod and agree that we see the rainbow butterfly in there. (F., Interview 1, August 30, 2013)
At the end of each class, Felicity awards the Enthusiastic Artist Support award.

For a student to receive the award, she looked for:

…somebody who did the ultimate role, which was “Try Your Best” and I secretly write that name on the sheet and the [student] announcer reads it out to the class…So those are little incentives that don’t cost me anything but it’s a nice way to settle down everybody at the end of the day and reward good behavior.” (F., Interview 3, November 6, 2013)

**Design space: Solution path.** Felicity’s planning process was linear and guided by her *Keynote* presentation:

As an art teacher, if you don’t get to a certain step then you’re kind of in trouble the next week sometimes. You need the paint to be dry before they can do the next step. So you have to get to this step…, and then get ready for the next step. And the projects do build on each other. So when I can line everything one slide after the other in a presentation, then I’m going through the steps in the order they need to be. So my presentation is my lesson plans. [I] need to get from Slide 1 to Slide 10 by the end of this first session and then from Slide 11 to Slide 15 by the end of the second session. And so this is just helping me plan out… there’s going to be 30 steps to this lesson and so now we’re halfway. If we have an extra 1 minute or so at the end of class, sometimes I can give the kids the fast forward view so they can get the big picture of all the steps that need to happen before we’re finished. (F., Interview 1, August 30, 2013)

Her planning process started with learning:

…what the possibilities were with the software, the hardware and if that would even benefit your students because using technology would only be if it enhanced the learning experience or it gave the kids a new experience that they couldn’t have had otherwise, which is relevant to learning. (F., Interview 1, August 30, 2013)

For example:

So let’s say…I learned a tool and then I thought about how it would apply in my classroom and then I think about how if I did it with my students, what would my steps be? And then I practice it myself and then I break it down into small enough pieces that I can learn how…I can think about
how to approach it with my students [so] that they can understand the concept and create something with it that is making a difference to their learning. So it’s a large…but it all started with understanding the possibilities first and then figuring out how to implement it. (F., Interview 1, August 30, 2013)

Another example of Felicity’s exploration process was regarding an animation application she obtained through writing a grant. She described the application and how she used it:

I’m focused on DoInk and all of its tools and abilities and I’m amazed with what it can do and how easily the kids can use it. I learned there’s a transparency button where you can change the opacity and transparency of what you’re animating and you can change your animated object, it can go on a path where it starts big and gets small. I’m like, “Oh my gosh! The possibilities!” So I did a lesson where Godzilla was going through a city. And he starts out big, as he enters the city and then as he gets closer to the vanishing point, he gets really small and disappears. And so I’m like, “There you go!” I’ve demonstrated a lot of really important things about creating the illusion of depth in animation that I wasn’t able to do before. I could only draw a still picture of Godzilla large and then maybe another still picture of Godzilla small but now I could show that I really understand that he goes from big to small as he travels towards the vanishing point. Never been able to do that before… I’m excited about the possibility of doing that with my 5th graders and then the spooky landscapes. (F., Interview 1, August 30, 2013)

Consistent with her blend of digital and physical art projects, she was planning to do the lesson as:

...a hybrid. We can still have a really nice painting experience and mix all our colors and stuff and then take a digital image of our painting and just do the animated ghost part as an extension. So then we aren’t trading our painting experience, which is really valuable. We’re just enhancing it with technology and doing something we’ve never been able to do. Have a transparent ghost get large and small and fly and all those things. (F., Interview 1, August 30, 2013)

She concluded this example by saying:
That is the excitement of understanding the possibilities. I was so excited that more I played, the more I thought, there’s so much you can do with this. (F., Interview 1, August 30, 2013)

Troubleshooting was another important element of Felicity’s process. She said:

I try to learn it all ahead of time and think about all the things that can go wrong and try to figure out how to troubleshoot ahead of time so that when we’re in the classroom and our time is limited, I only see them 45 minutes a week, so for things to have, for me to have a total fail, I don’t get to make that work for a whole other week. So I need it to work. (F., Interview 1, August 30, 2013)

Her students were “always surprising me by what little things they don’t get or understand. So the more I’m working with them, the more I realize what I need to say to prevent issues” (F., Interview 1, August 30, 2013).

Felicity was flexible in how she planned lessons from week to week as well as allowing for creative direction from her students. With respect to planning:

I have big ideas, “We’re going to do this” and then all of a sudden, when it gets down to “Oh, they’re coming today”, I need to exactly know what we’re doing today, [but] I won’t really know what we’re doing next week until I see how it goes today. (F., Interview 1, August 30, 2013)

An example of Felicity allowing student creativity was:

Let’s say we’re going to make a movie. We’ve got the big idea and I’m flexible about what direction they want to go and what tools we’re going to use and how it’s going to look. They’re going to be able to add their own personality to it but I am not quite sure what next week is going to look like because it’s going to depend on how far we get this week. So this week, I’m going to pull out the cameras, I’m going to give them these instructions and I’m going to give them a timeframe. I’m going to give them a few parameters and then they’re going to go at it. (F., Interview 1, August 30, 2013)
Another aspect to Felicity’s design process was to change lesson from year to year. Her rationale was “idea of bringing in something fresh and exciting and relevant to my students” (F., Interview 1, August 30, 2013). An example she gave was implementing a lesson before she had an interactive whiteboard and after:

So I have a lesson from like 2005 that I repeated again in maybe 2011. And I decided I’m going to just put the results side-by-side and ask myself “Did the kids do a better job? Do they demonstrate that they understood? Would the old [lesson] show more struggle versus the newer one?” and it was so clear. (F., Interview 3, November 6, 2013)

Before she was able to project and draw on the interactive whiteboard demonstrating was time consuming. The board allowed her to:

…do it digitally and [the software] saves [images] and then we just show the next step and the next step from there; that made a huge difference for me where it meant I could walk around the room and see how they’re doing because I’m not glued to the front of the room anymore. And the projector made it big and so, and I could zoom in if I needed to. (F., Interview 3, November 6, 2013)

**Goal State.** Felicity was not required to turn in written plans. She said:

“everything is in, my whole lesson is a Keynote file” (F., Interview 2, September 23, 2013). Her Keynote slides provided prompts for what to do next in a lesson:

...my slides are giving me cues… This is your next step. You’re going to look at abstract art. You’re going to give it a title. So where you’re going to be for titling, the kids can all be nearby. (F., Interview 1, August 30, 2013)

If she had to turn in her lesson plans the dynamic nature of her Keynote presentation would be flattened:

You don’t see the animations there but I don’t know if the animations really are necessary to see. I mean, that’s just you know, “In comes the blue! Now we pour the blue. In come the red! You don’t need to see that
but if [administrators] came and did an observation in my room, they may be a little bit more impressed then because I did take the time to do that. (F., Interview 2, September 23, 2013)

**Felicity’s teacher planning problem space.** Felicity’s school followed a traditional curriculum that was guided by the Common Core State Standards for teachers (see Figure 12). She taught Specials classes to elementary students at a public school with semi-regular schedule that was subject to being cancelled with no notice. Felicity preferred to use iPad applications, an interactive whiteboard, and a document camera when integrating technology into instruction. Her problem statement tended to be process-oriented because of she taught art and she did not often collaborate with teachers to plan lessons. Drawing from her prior knowledge and experience with making mistakes, Felicity created a flexible structure of activities and routines. She described a typical lesson as having three activities with routines before and after each activity. In Felicity’s classes, especially with her youngest group, the routines were step-by-step processes like her activities. Her solution path was technology focused during which she explored the possibilities of a particular tool and how the affordances of that tool fit into her content. Characteristics of her solution path emphasized creation and included flexibility and troubleshooting. Felicity’s goal state was her presentation for her students.
Henry

Henry entered teaching as a career after spending time in medical research. He was passionate about his career choice:

When you decide to become a teacher, it’s really a tough decision. You really have to want and love to do this. You can’t just do it and have people hand you things to do and say, “Go take it to the class.” I love what I do and I love interacting with the kids. When that is your ultimate goal, then anything you do to get to that goal is a labor of love. It’s something that you don’t mind doing. I can’t tell you how much money I’ve spent, how much time I’ve put into some of these ideas that I’ve come up with but if you were to ask me was it worth it? I would say “Heck yeah”. I wouldn’t trade it one bit (H., Interview 1, September 4, 2013).

He held a doctorate in Physics, bringing several “characteristics from the academic world into my teaching one” (H., Interview 1, September 4, 2013). During his twelve years as a teacher, Henry has taught Physics, AP Physics B, AP Physics C. Once he wrote a lesson and perfected it, he enjoyed sharing his work in academic journals. He has written
several lessons and projects that he submitted and published in journals. Henry was the most experienced teacher out of four other Physics teachers in his department at a large public school in the suburban Southwest. He enjoyed creating “out-of-the box projects,” one of which high school student invented toys to present to younger students. He liked to involve “elementary kids because I want them to get excited about science and about our high school and I think at that age, believe me, they’ll remember it.” Some examples of his conceptual demonstrations included using pressure calculations to determine the weight of a car and demonstrating sound waves using a Slinky (H., Interview 1, September 4, 2013; H., Interview 3, November 4, 2013).

Henry has participated in several contests and won technology resources for his classroom as an innovator. He explains his motivation for applying for the Teacher Innovation Award:

Anytime I do something that I think is successful, that is positive, that the kids have really benefitted from; I like for other teachers to hear about it, maybe it’s an idea they could possibly use at their school, within their setting. So I’m always looking for and always willing to share the instructional activities and projects that I do in the hopes that [the sharing] might benefit other teachers (H., Interview 3, November 4, 2013).

This idea of sharing is consistent with how he views his work as a teacher:

I certainly don’t mind sharing anything that I’ve got. I don’t keep ideas and activities to myself… All [people] have to do is ask me…and I will give everything I have and tell you everything I know (H., Interview 3, November 4, 2013).

Technology was “what really gets me going;” and served as a motivator for both Henry and his students (H., Interview 1, September 4, 2013). He encouraged his students to use technology to solve problems in science and to “get their hands on it and be able to
play with it.” He used demonstrations related to real world applications to prompt students “to start thinking about [science] by seeing some of the things that are right before their eyes.”

According to Henry, technology was a necessary skill and created efficiency in his classroom because “it better addresses all of the different learning capacities, experiences and backgrounds that might stimulate the kids to want to learn more or to better take in knowledge” (H., Interview 3, November 4, 2013). He said:

But let’s face it, we live in a technologically advanced and consistently evolving world. So I think we would be doing [students] a huge disservice if we didn’t at least expose them to the different types of technologies…I think it ill prepares them for the workforce, for what it’s going to be like in college [if we don’t].

Henry had what he described as a natural curiosity for technology:

I am a career-long teacher. I am a life-long learner. And I’m always trying to learn different ideas. The day that I stop wanting to learn, is probably the day I oughta hang it up. And that’s the mindset that I think that every teacher has to embrace. (H., Interview 3, November 4, 2013)

According to Henry, one role of technology in teaching was to save time and advance students science knowledge through technology: “I understand that there is a lot of available technology but what I do is look for those components that I think are going to help me accomplish what I want to do in a more efficient and a more effective way” (H., Interview 3, November 4, 2013). He said:

I’m very not only cognizant of the fact that Science is revolutionizing technology but I want to know… what are we doing Science-wise to help advance technology that we could potentially use for our kids? For learning? (H., Interview 3, November 4, 2013)
Henry’s Planning Task Environment

The school environment. Henry taught at a large public magnet school for Arts, Law, and Science with over 2500 students in grades 9 – 12. As a magnet school, the traditional curriculum guided by State standards was enriched by the opportunity to take classes geared towards specific career strand. It was free to attend Henry’s school if students lived within a zone designated by the school district, but to participant in the magnet program, in-zone and out-of-zone students had to apply.

Henry taught General Physics, which emphasized processes and problem solving. His state had standards that Henry was required to follow to guide the development of his instruction. Additionally, his school district mandated laboratory experiments that he and his colleagues had to conduct throughout the school year.

While some science courses are subject to state testing, Henry’s requirements recently changed. Usually students in his course are required to take State mandated tests in Physics, but this year the State legislature decided to “cut down the number of tests that a senior would have to take to graduate… Physics now isn’t subject to state testing,” as an individual course (H., Interview 2, October 4, 2013). Students had to take a state-mandated test in Science, of which Physics in a prominent part, which lessened some of the pressure in teaching the course (H., Email communication, March 15, 2014).

Classes stared at 9:00am and ended at 4:10pm. His schedule was traditional on which he saw all of his students every day for approximately 50 minutes and had two 50-minute planning periods: an individual planning period for holding parent conferences and taking care of administrative tasks and a common planning period. He viewed having a common planning time as a positive experience:
Well first of all… I’m very fortunate in that we have a very cohesive department. We work very well together… the school has gone out of their way to make sure that we all have the same planning period. (H., Interview 2, October 4, 2013)

During his common planning time, teachers “get together in the department meeting and we go over data, lesson planning and instructional strategy” (H., Interview 1, September 4, 2013; H., Email communication, March 15, 2014). Henry also referred to having ample amounts of planning time during which five teachers “divide and conquer” by assigning planning responsibilities (H., Interview 2, October 4, 2013).

**The teaching environment.** Henry’s average class size was 30 students. He admitted that the first few years of teaching were difficult until he “learned to master the death stare” (H., Interview 2, October 4, 2013). The death stare was a look that meant “I expect the kids to listen to me when I talk.” He said, “Once a teacher has a death stare, they don’t mess with you.” Developed over years of experience, Henry stated classroom management had:

...taken awhile to master but classroom discipline at this point is a minimal thing for me. And I’m not saying that because I think I’m one of the best there is, it’s just I don’t tolerate it… And they don’t want to leave the class. They want to stay. So I say, “If you’re to stay, then you’re going to behave. I just ask very little of you. I expect you to respect me and my time” (H., Interview 2, October 4, 2013).

His management style reflected his personality: “I’m not an uptight person. I’m very animated. I like to laugh as long as it’s not at anybody’s expense. I love to have a good time” (H., Interview 2, October 4, 2013). He attributed the respect his students gave him to:

So the kids know that I care about them a lot and that’s something that I try to foster from the very beginning… I think because I’ve taken that time
to foster those relationships, that the kids know that [death stare] look… I like to smile. I like to laugh. But when I’m ready to teach, I need you to listen to me. And it’s taken awhile to learn and to implement [classroom management] but it’s paid off in the long run because I don’t have a lot of discipline issues; not really much at all. (H., Interview 2, October 4, 2013)

**Resources.** Henry described his situation in terms of resources (see Table 7) as “very fortunate,” and he has “never really been in want of anything” (H., Interview 2, October 4, 2013). He had an iPad that was provided by his school and had just received class sets of iPads for the Science department. Henry said that the teachers “still had some learning to do” and had to “get up to speed” with how use the iPads but once they did, “we’ll be able to implement that into our labs” (H., Interview 2, October 4, 2013).

Henry was the only teacher in his high school to have an interactive whiteboard. He received the board as part of a competition he entered. The board:

… allows me to bring [the lesson] to life. [T]here are a lot of things that I could do on the board where the kids can see it… address[ing] the visual [and] the auditory [learning styles]… I might not be able to do as good a job on a standard whiteboard. (H., Interview 3, November 4, 2013)

Henry used textbooks to supplement to his curriculum and they were mainly for “additional review problems should the students need remediation or reinforcement, or as a source for students to study for an upcoming quiz/test.” (H., Email communication, January 30, 2014)

Occasionally, Henry would bring in human resources to help teach Physics. For example, “we arranged to have a police officer come and talk to kids about different aspects of Physics and police work” (H., Interview 3, November 4, 2013). The police officer demonstrated the wave properties of light using a radar gun.

Table 7
Survey results of Henry’s technology resources and frequency of use

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Available</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Computers located in your classroom everyday</td>
<td>1 – 5</td>
<td>Often</td>
</tr>
<tr>
<td>Computers that can be brought into your classroom (e.g., laptops on carts)</td>
<td>6 – 10</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Computers in the computer lab</td>
<td>31+</td>
<td>Sometimes</td>
</tr>
<tr>
<td>LCD or DLP projector:</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Video conference unit</td>
<td>Yes</td>
<td>Never</td>
</tr>
<tr>
<td>Interactive whiteboard (e.g., SMART Board, Activboard)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Classroom response system</td>
<td>Yes</td>
<td>Never</td>
</tr>
<tr>
<td>Digital camera (still or video)</td>
<td>Yes</td>
<td>Rarely</td>
</tr>
<tr>
<td>MP3 player/iPod</td>
<td>Yes</td>
<td>Never</td>
</tr>
<tr>
<td>Document camera</td>
<td>Yes</td>
<td>Never</td>
</tr>
<tr>
<td>Handheld device (e.g., iPad, iPod, Windows Surface, other tablet)</td>
<td>Yes</td>
<td>Rarely</td>
</tr>
</tbody>
</table>

Henry’s Planning Problem Space

**Problem statement.** Henry took a hands-on, real-world approach to teaching his content. Henry used a building block approach to the curriculum. “Physics starts with the fundamental quantities of motion but as you move along throughout the year, all the quantities build upon themselves” (H., Interview 2, October 4, 2013). He began the course with the concept of motion and then force, which answered the question: “What caused things to move?...[T]hen we talk about well, as we get them to move, what can they do? I’m talking about work and energy.”

To teach his curriculum, Henry stated that he “would rather do labs than just introducing a topic because I think a lab is really important because they get to do a hands-on type of activity and they get to observe as they’re moving along” (H., Interview
2, October 4, 2013). Henry felt it was important to teach Physics through practical activities using demonstrations. The purpose for using demonstrations was that:

I not only want them to hear the content but to see it. I like to show it to them... for example we’re going to get to temperature and we’re going to talk about pressure. I have a whole series of demos that I like to do to. It gets them to start thinking about it by seeing some of the things that are right before their eyes. And so those demos, I like to involve, I like to evolve into learning sessions. (H., Interview 1, Sept 4, 2013).

Through demonstrations, Henry provided his students with “a lot of open-ended ways to support or foster their creativity.”

I want to ask them questions: “Why do you think I’m going to do it? What do you think is going to happen? Why would it have happened? What would’ve happened if I did this?” I mean, I want them to critically think about it even in that little two or three minute segment. I want them to get more out of it than just ooh and ah...I want them to get something substantive, something concrete out of it. (H., Interview 1, Sept 4, 2013).

**Design space: Activity structure and routines.** Henry had two main types of activity structures: one for regular class days and one for laboratory days. On regular class days, he either started class with a *bell ringer* or ended it with an *exit ticket*. A bell ringer was “something to get them engaged in the lesson, at least in the very beginning” (H., Interview 2, October 4, 2013). Another routine was as soon as the bell rang for class changes, Henry would:

… step outside of my classroom [to take] attendance as the kids are walking into my class. So I don’t take time from the first bell ringing, I’ve already got at least 80-90% attendance already done because attendance is very important. (H., Interview 2, October 4, 2013)

Exit tickets served the same purpose as a bell ringer but because the class period was 50 minutes, both were not implemented in the same class session. “So we basically switch
off. Once a week we’ll do an exit ticket but for the other 4 days of the week, we’ll do a bell ringer” (H., Interview 2, October 4, 2013).

The rest of a regular class day was dedicated to a combination of teacher-led demonstrations, student application problem sets, and whole group discussions about them. The demonstrations were a strategy to prompt students to “start thinking about [science] by seeing some of the things that are right before their eyes” (H., Interview 1, September 4, 2013). These demonstrations “evolve[d] into learning sessions,” during which:

I give them maybe 15 or 20 minutes and then I bring them back and I say, “Well let’s go over these problems on the board. Do you have any questions?” And then if not, then we go back and say, “Now you carry on with the next set of questions.”

The structure for lab days was different from a regular class with the exception of a bell ringer or exit ticket. Students were provided with a copy of the lab instructions prior to the class of implementation. During the preview of the lab, Henry did not provide students with a “step-by-step [of] what they’re going to do… But I will probably give… more explicit instructions on [the follow class session] and then just let them add it” (H., Interview 2, October 4, 2013). To save time, he would put together some pieces of the lab equipment so “they don’t spend a lot of time you know, tinkering around with it” (H., Interview 2, October 4, 2013). “Ideally, I would like to place the equipment on the table and let them put it together, let them figure it out but we only have 50 minute periods.” He liked to “give them enough information to get them to the lab table and start exploring without already telling them what they’re going to see.”
The formal write-up was the culminating activity of the experiment and “pretty much addresses all the major steps involved in the experimental process”: purpose, procedure, results, conclusion, and sources of error (H., Interview 2, October 4, 2013).

Regarding the results section of the lab write-up, he said:

I want to make sure that I can see all the data recorded in a table. Everything has to be labeled appropriately, especially the graphs. I’m really uptight about the graphs because I always tell them, “A picture is worth a thousand words”… the same thing applies for a graph...

Henry enjoyed lab days: “it’s great from the hands-on experience but it’s also great to get them out of their seats and back at the table and just doing something they wouldn’t ordinarily do” (H., Interview 2, October 4, 2013).

**Design space: Solution path.** Henry described himself as an *over-planner* because he hated “dead air” time in his classes (H., Interview 1, September 4, 2013).

When integrating technology, Henry said about his planning process:

I have to see the end result. I have to see where this is going. I have to know what I’m going to expect. When I do that, when I have an endpoint, then I start talking about or start thinking about how am I going to get there. What am I going to do? I want to make it challenging. I want to make it interesting. A lot of these ideas come about with a lot of iterations. I’m constantly thinking about it. Even when I go to bed at night, I have these ideas going through my mind and …when I get up [the next morning], I [think] “Oh, hey! That’s a great idea! Let me go for it!” [Planning is] not something that I put five minutes in, ten minutes in. It is an ongoing series of iterations. So once I have something set in my mind that I think is going to work, it is going to be creative, it’s going to be innovative, [and] involve different components, then I start writing with pen and paper and putting it on paper.

Built into his planning process was also the notion that everything might not go as planned: “I am always prepared to accept failure but at least I tried to do it” (H., Interview 1, September 4, 2013). Henry approached technology integration from the
perspective that difficulty with teaching a lesson when the technology failed was a
learning experience rather than an unsuccessful lesson: “I go into every lesson always
knowing that something can and will, probably will go wrong,” but:

There is no clear-cut recipe for success that every time you do ‘this’, you
will always get ‘that’. I have had some projects that I thought were good,
I did it, it didn’t come out the way I wanted it to but then I re-tooled it and
then the next year, it worked out phenomenally.

Henry paid attention to the unsuccessful part of a lesson and during his redesign process
from year-to-year, he asked, “Well, is there something I could do to make it better?” (H.,
Interview 1, September 4, 2013) He also acknowledged his successes and appreciated his
own efforts to improve a lesson by saying, “And in some cases, I have made it better and
then it makes me proud, let’s just say that I like the way it comes off” (H., Interview 1,
September 4, 2013).

One strategy that Henry cycled through several times in a lesson was defining
terms related to the particular concepts he was teaching. For example, at the beginning of
a lesson he said, “Let me first of all talk to the fact or give you a general idea of what we
mean by waves” (H., Interview 3, November 4, 2013). After illustrating the terms
associated with waves through a demonstration involving a Slinky, he then adds more
specific foundational vocabulary:

…we need to know what these words mean. What does a crest mean? What does
a trough mean? What does amplitude, what does wavelength mean? What does
period mean? What does frequency mean? They need to be adept at trying to
understand what these terms are. So then, once we do that, then we start delving
into the applications and this is where we have a lot of demonstrations.

He approached lesson planning with technology to make sure “these kids have a
fairly solid experience and I’m presenting it and technology is the way to do it” (H.,
Interview 3, November 4, 2013. If teachers “embrace the principle that, ‘Yeah, I think technology is important,’ and are open-minded, “it’s almost like a normal process.”

**Goal state.** Henry preferred his lessons “set in stone about a week to two weeks before so I have an idea” of what to bring to his collaborative meetings. At these common planning meetings, the Physics teachers:

…formally decide that… this activity suits us best for starting the unit… we need to follow up with this type of activity and then let’s throw in a quiz… how about a lab? I like to come in [to a meeting] somewhat prepared: A one to two week window where I have an idea of what I’m thinking about doing with my kids and then I bring it before the group and we decide collectively how to proceed. (H., Interview 2, October 4, 2013)

He was not required to turn in lesson plans, but used his dedicated planning time to write “extensive lessons plans” that were: “etched in stone what we’re going to do, when we’re going to do it, how long we’re going to do it, how do we want to assess and then we go on the next unit or lesson” (H., Interview 1, September 4, 2013). His department’s plans were made available to students through the school’s online course platform.

![Henry’s Teacher Planning Problem Space](image)

*Figure 13. Henry’s teacher planning problem space.* This model is summary of Henry’s planning. Images, © 2014 Common Craft®.
Henry’s teacher planning problem space. Henry’s school followed a traditional curriculum supplemented by magnet courses that was guided by State Standards for teachers (see Figure 13). At his public high school, he taught Physics on a regular schedule that did not change from day-to-day. He often used an interactive whiteboard and a variety of materials for conducting demonstrations during his instruction. His problem statement tended to be process-oriented and he planned lessons collaboratively with four other Physics teachers. Drawing from prior knowledge and experience, Henry created a flexible structure of activities and that either started or ended with a routine. He described a typical lesson as series of four activities: demonstration, student application in small groups, whole group discussion, and student application in small groups.

Henry’s solution path was content focused and characterized by troubleshooting, over-planning, real-world applications. Although not required to turn in a plan, Henry’s goal state was a written lesson.
Laurie

Collaborator.

Laurie has been teaching for sixteen years and as a media specialist and taught all content areas to students in grades K – 6. She described her main role as “either helping teachers find the right resources or bringing the technology piece to the lessons” (L., Interview 1, September 4, 2013). Much of her teaching was in collaboration with other teachers in her school. “I think that collaboration leads to better plans because bouncing ideas off of each other helps sometimes, I think [collaboration] leads to the best way to teach something” (L., Interview 3, November 5, 2013).

Laurie felt it was important that technology be a “natural fit for the lesson because not everything will work with every group of students or every lesson” (L., Interview 1, September 4, 2013). She described what she meant by natural fit for technology in instruction:

If it’s something that is a standard that can be taught better in a different way not using technology, then I don’t think that we should push it and make it happen if that’s not the most efficient and best way. But if we can integrate technology into teaching those standards, I think it’s always a motivator for kids and definitely gives them those 21st century skills that they need. So if it fits, then [the teachers and I] definitely use it.

According to Laurie, “anytime you want an audience for your kids, technology is a good way to go” (L., Interview 1, September 4, 2013). She admitted that technology could be “overwhelming” because it “takes a lot of thought, it takes a lot of planning and it’s definitely not easy.” Laurie, however definitely saw the benefits, “the kids love it…we want our kids to be excited about learning and you can’t ask for more than that. It’s so worth it when the kids get excited about it.”
To learn about new resources to assist her coworkers and teach students, Laurie explored the Internet and subscribed to several blogs. About learning how to use these resources, Laurie said:

I’ve gotten good about just getting in and just trying it. Once I see something that I think looks good, then I can follow through and figure out how it all works. So that’s how I learn most (L., Interview 3, November 5, 2013).

Laurie’s Planning Task Environment

The school environment. Laurie’s elementary school was located in the rural Southeast and had about 960 students. It was free to attend Laurie’s school for students who lived within a zone designated by the school district. The school offered a traditional curriculum guided by Common Core State Standards. Laurie’s curriculum was determined in part by state and National standards for media specialist as well as the standards that teachers in her school were required to follow. American Association of School Librarians (AASL) outlined the National Standards for the 21st-Century Learner. These standards outline skills, action, responsibilities, and self-assessment strategies for finding information through multiple literacies including digital, visual, textual, and technological (AALS, 2007). Her curriculum required that she focus on reference sources and how to use the library.

School started at 7:20 am and Laurie was usually at school by 7:00 am. After school ended at 2:15 pm, Laurie spent from about 2:30 pm – 4:00 pm helping teachers and “once they leave, then I can do ordering, cataloguing, planning, things like that” (L., Interview 2, October 23, 2013). Because Laurie was in the Media Center, she did not have a regular schedule like the classroom teachers did:
In fact, I don’t have a scheduled anything. I don’t even have a scheduled lunchtime…So I usually eat in the Media Center while I’m walking around the shelves helping kids. I tell them I’m the only one that gets to eat in here because I don’t get a lunchtime…I don’t get a scheduled planning or lunch or anything. (L., Interview 3, November 5, 2013)

Her principal would allow her to leave parents in charge of the Media Center but she did not feel comfortable doing so.

Although Laurie did not have a set planning time, she still worked with teachers to set times that classes visit the Media Center. “I see all of my kindergarten classes once a week for 30 minutes” (L., Interview 3, November 5, 2013) for story time and to check out books. For grades 1 – 6, the teachers choose how they want to schedule time to check out books: “Some of them reserve a weekly time and they bring their whole class. And some of them choose to send small groups whenever it’s convenient for them.” As for teaching her curriculum requirements, she usually saw every student in the school at least once a month, or every three weeks because her school was on a balanced calendar, which provided more frequent breaks during the regular school calendar and a shorter summer break.

Laurie also sponsored an after school book club that participated in a state reading competition in which students answered questions based on a collection of books selected on a yearly basis.

The teaching environment. Laurie’s classroom was the media center and her average class size was 27 students. One thing she noticed about student abilities this year was how the fourth grade students at her school were grouped. This grouping influenced how she planned activities for students when they came to the media center:
I can see a big difference between the high group and the low group. So that has affected my planning for the next teacher who is coming in next week to do figurative language [with her low group] because the activity was grouped for her high group but I need to find something different for her low group. (L., Interview 2, October 23, 2013).

She explained students in the low group were working below their current grade level and the high group referred to students at or above grade level. For her low group, an activity she planned on figurative language “was too long for them” (L., Interview 2, October 23, 2013). To hold their attention longer, she decided to modify the lesson and integrate technology using her class set of iPads and Quick Response (QR) codes, which is a two-dimensional bar codes to identify information: “Having them scan to get the right answer, check their work or something like that because they need something that’s a little bit shorter that will keep their attention.” She said,

...the most important thing to me [was] that I try to make sure that the activity is a fit with the content, that it really serves a purpose. And sometimes that purpose is, like in the QR code activity, I think that [by using the] QR codes, you can do a worksheet in that, …and they think it’s the neatest thing ever. So sometimes the purpose really is to engage students.

**Resources.** In addition to her interactive whiteboard and class set of 20 iPads, Laurie had ten desktop computers in the media center (see Table 8). She also enjoyed using wikis, blogs, and glogs with her book club students. Wikis provided a collaborative space in which Laurie and her students “could work together and they could… to add their own questions… and then they have access to everybody else’s questions” (L., Interview 1, September 4, 2013). Laurie tested using blogs before introducing them to students. “My daughter was in our book club last year, … she was kind of my guinea pig. I had her at home testing out the blog and posting comments and
making sure that worked before I introduced it to the kids.” She thought *glogs*, online interactive posters created using *Glogster*, “would be a great way for our book club kids to share what they thought about the books.”

As was common in elementary school classes, Laurie also had parents volunteer to help with lessons, or serve as human resources for technology integration. To help very young students create digital stories, she said, “we have some dads at our school who are interested in helping. So we each, the teacher and I, are going to take a group and then the dads who are in will help with the groups too” (L., Interview 3, November 5, 2013).

Table 8
*Survey results of Laurie’s technology resources and frequency of use*

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Available</th>
<th>Frequency of use</th>
</tr>
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<tbody>
<tr>
<td>Internet</td>
<td>Yes</td>
<td>Often</td>
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<tr>
<td>Computers located in your classroom everyday</td>
<td>31+</td>
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<td>Yes</td>
<td>Often</td>
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<tr>
<td>Video conference unit</td>
<td>Yes</td>
<td>Sometimes</td>
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<tr>
<td>Interactive whiteboard (e.g., SMART Board, Activboard)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Classroom response system</td>
<td>Yes</td>
<td>Sometimes</td>
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<tr>
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<td>Often</td>
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<tr>
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<td>DNR</td>
<td>DNR</td>
</tr>
<tr>
<td>Document camera</td>
<td>Yes</td>
<td>Often</td>
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<tr>
<td>Handheld device (e.g., iPad, iPod, Windows Surface, other tablet)</td>
<td>Yes</td>
<td>Often</td>
</tr>
</tbody>
</table>

Note: DNR = Did not respond.
Laurie’s Planning Problem Space

Problem statement. She admitted that the “teachers are more of an expert on the curriculum, you know, they know exactly what their kids need to know, have their standards memorized” (L., Interview 1, September 4, 2013). One thing she does to assist teachers at the beginning of the school year is give them a list of library media skills that she would like to teach to students and ask for teachers’ input. “If there’s anything they want me to take out or add to and I always give them the option that if there’s something that comes up later, we can always add to the list and not take away, you know, so they come in [to the media center] more.”

Design space: Activity structure and routines. Laurie liked to start her lessons with students seated on a rug that was located in front of her interactive whiteboard. Her rationale for this strategy was that “I don’t think there’s as many distractions” (L., Interview 1, September 4, 2013). With students on the rug, she typically started a lesson by informing students what they were going to do and conducted a short teacher directed activity to communicate and model new content. To engage the students with technology, she reinforces this new content with an instructional video to provide an alternative perspective. Before students were turned loose in the media center, Laurie reviewed routine behavior expectations. The next and main activity of her lessons was student directed and either performed individually or in small groups. For example, in the Kindergarten class working on digital stories, students worked by themselves or in pairs to write and record their stories. Older students, in second grade for example, video recorded each other as they read aloud in different voices to signify different characters in
These students were taught how to upload their videos to their teacher’s blog to show their parents and grandparents that they had mastered the standard.

**Design space: Solution path.** Laurie described her style of planning as “kind of backwards design,” in which:

I start with “This is what the kids need to know” and then go backwards from there. What activities, what technology, what resources are best to meet that objective. (L., Interview 1, September 4, 2013)

She also considered herself a risk-taker when it came to technology, but “I would never consider myself a risk-taker in general” (L., Interview 3, November 5, 2013). Laurie attributed her fearlessness to a graduate school professor:

When I was in grad school, our professor had us do our assignments using a new kind of technology. We had to create a blog or we had to create a wiki or something like that and I think that really just helped me not be afraid to jump in and try new things.

Compared to other teachers in her building, “I’m the first person in my building who has used [a resource],” because “a lot of teachers are afraid to do, to try new things and to experiment” (L., Interview 3, November 5, 2013). Because she tended to serve as the technological hub for her school, her principal asked her to apply for the Teacher Innovation Award.

Laurie elaborated on the difference between some teachers at her school and her perspective:

[Teachers] are afraid that the kids are going to learn faster than they are. Or be able to know things before they know it and that doesn’t bother me. I had a kid in the other day and he said, he had worked on the technology project and he said, “Oh. I’ll show you how to do this”. You know, we were just kind of learning together. And I think that does bother some teachers. (L., Interview 3, November 5, 2013)
To anticipate the “technical aspects” of a lesson that can cause issues, Laurie liked to:

…know the technology and [if] the teacher [also] knows the technology, we can teach it to the kids and make sure that we don’t have any hiccups. We always make sure we have backup batteries and we test out the connections and see if we could download their video…But always planning and testing everything in advance is an important part of it. (L., Interview 1, September 4, 2013).

Although she tried to prepare for technology issues, when something went wrong:

It doesn’t bother me. I can quickly talk to the teacher about what we need to do to regroup the lesson or to make sure that we’re both on the same page, that we’re wanting the same outcomes for the lesson, that we have the same ideas of what we want the kids to have and to be able to do at the end of the lesson (L., Interview 1, September 4, 2013).

For Laurie, an example of changing her plans on a year-to-year basis was evident in how she ran her book club. After five or six years of sponsoring the club:

I got my format down and everything was running smoothly but then that’s kind of to me an indication that sometimes we need to shake things up a little bit and add some more pieces to it. Instead of having a traditional book club, I thought I’d be inventive and have the kids have an audience for their reading because in the past we’ve always read our books in groups, …[had] our little questions in groups but then when book club was over, that was it. I decided to have the blog first because then I thought that’s something that the kids could show their parents and their parents would know what their kids were reading and what they thought about the books. We could share it with other teachers and they could show their kids and they could kind of promote the books that way. (L., Interview 1, September 4, 2013)

Laurie preferred to have a plan, but tried “not to be too regimented with teachers and kids,” because:

Well with kids you just never know what’s going to come up…Even if it’s just one class that’s visiting the media center, you never know when there’s going to be a fire drill or somebody scheduled a lesson during
picture time or something like that. Not to mention all the limitations … with the kids and their ability level as far as the technology goes” (L., Interview 1, September 4, 2013).

This flexibility was coupled with a sense of confidence about her success with technology integration. Laurie attributed her unique position as a media specialist, in which she was familiar every student throughout their elementary school years, to her understanding of the abilities of the students. Because she knew what students “did this last year in 1st grade, I know we can take that and build on it in 2nd grade,” (L., Interview 1, September 4, 2013). She could readjust a lesson to “give them a little more support or guidance or instruction.” Reflecting upon her past lessons, she stated, “I don’t know that we’ve tried anything that hasn’t completely worked (L., Interview 1, September 4, 2013).

Laurie’s collaborations with teachers who were interested in using technology tended to be with “the ones who are open to new ideas” rather than “the teachers who maybe are more regimented in integrating technology, they’re not going to be the ones that I work with regularly.”

**Goal state.** Laurie liked “to have a plan” and she wrote “lists for everything” as a planning strategy (L., Interview 1, September 4, 2013). She was not required to turn in lesson plans and if her plans were written she tended to deviate from them as needed.

**Laurie’s teacher planning problem space.** Laurie’s public elementary school followed a traditional curriculum that was guided by the Common Core State Standards and the AASL Standards for media specialist (see *Figure 14*). She did not have a regular schedule as classroom teachers did. Instead she made the media center available to teachers and students. Laurie preferred to use Internet-based tools and iPads when
integrating technology into instruction. Her problem statement tended to be technology-oriented because of her role as a media specialist and she planned collaboratively for or with teachers. Using her knowledge and experience, Laurie created a flexible structure of activities and routines. She described a typical lesson as having two activities with routines before and after each activity. In the classes Laurie worked with, especially with the younger student, the routines tended to be management routines to focus student attention. Her solution path was technology focused during which she explored the possibilities of a particular tool and how the affordances of that tool fit into her content. Characteristics of her solution path included flexibility, troubleshooting, and drawing on student’s expertise. Laurie’s goal state was a written list of items to complete.

![Image](image.png)

*Figure 14.* Laurie’s teacher planning problem space. This model is summary of Laurie’s planning. Images, © 2014 Common Craft®.
Megan

Artist

Megan had been teaching for 16 years and taught high school students Art I - IV, AP Studio Art, and Digital and Advanced Digital Photography. She mostly grades 9 – 11 with an few high school seniors who have not yet met their Fine Arts requirement to graduate. Megan had many years invested in her current school. She not only graduated from there as a student but has taught there for the past eight years.

Her passion was Art History and she held a Masters in Art History. She said:

… I love history and I think it’s the old [adage that], those who don’t know it are condemned to repeat it. I really do want [students] to know where they came from and where this Art form came from and the fact that you can be a modern artist but you can’t escape the past. Every artist who is doing something is building on what came before, even if you’re just reacting against it (M., Interview 1, September 18, 2013).

Megan’s philosophy in life was that, “If something comes across your desk, do it,” which was not only how she got involved in her school but was her motivation for applying for the Teacher Innovation Award.

Although Megan described technology as a supplement to her teaching, for her Digital Photography courses it served as a medium and provided a way “to open up the world of Art History” (M., Interview 3, November 5, 2013). She admitted that, “I’ve probably used [technology] less than a lot of other people because I don’t’ want the students to start to rely on it because so much of what I do has to do with what happens in their brain before they even pick up a pencil.” What technology did do for here students was to:

…let them see ‘Here’s what a Caravaggio painting looks like’ and ‘Here’s what it looks like compared to a Rembrandt painting’… to get those great
images and to say “Here, look. This is the paint that Van Gogh smushed up. And you can see that. And here’s the texture of the canvas showing through”. So in those ways, that for me is the benefit because they can get closer to artwork than I can get from a 3x5 inch reproduction in a book.

When something went wrong and she lost access to technology, Megan stated that she could live with out it because technology “doesn’t replace good conventional teaching material, content.”

In terms of learning technology, Megan said, “I learn technology when I have to” (M., Interview 3, November 5, 2013). She further explained:

I learn it as I need it. I’m not going to be the person who goes to take the weeklong course in whatever. I’m going to call our IT guys, and say “Here’s what I need to do and NOW!” And I don’t always call them. Usually I call them after I’ve either played around enough and have not been able to do it or been able to get something done partway.

Megan’s Planning Task Environment

The school environment. Megan’s school was a small Christian school in the rural Southeast that served grades Pre-K – 12. The school offered a college preparatory curriculum that emphasized moral and spiritual growth through Biblical values. Students at her school go through an admission process and pay tuition. Although the state in which Megan taught adopted the Common Core State Standards, the state had their own framework for Visual and Performing Arts. The framework was intended to guide the development of curriculum and instructional practices and provided a set of competencies that Megan was required to teach. The competences were broad goals in which students were expected to create, communicate, analyze, interpret, understand the historical context, and appreciate diverse meanings for works of art.
Megan’s school served approximately 945 students in grades K – 12. She taught on a traditional schedule during which she saw all of her students every day for approximately 50 minutes. Megan had one 50-minute planning period. Her school had four regular schedules that ran as needed during the school year: Schedule 1 with chapel, Schedule 2 without chapel, Schedule 3 for pep rally, and Schedule 4 for half day. On Schedule 1, students attended seven class periods a day lasting 50 minutes each. The first class begins at 8:00am and students are dismissed at 3:15pm. Teachers are required to arrive by 7:45am and Megan is usually at school by 7:30am. Two additional non-academic periods were built into the regular school day. Activity/Chapel is a 20-minute period that occurs mid-morning, during which students participate in bible study, worship, or teacher-sponsored clubs. This period was also to facilitate other non-academic school events such as voting for homecoming king and queen, distributing school pictures, and college representative visits. The Afternoon Break period occurred after lunch for ten minutes. For high school students, it occurred at the end of their lunch period.

Megan’s planning time was scheduled during 6th period, or from 1:07pm – 1:57pm. Sometimes other school responsibilities, such as “changing out the bulletin boards with student work on it” (M., Interview 3, November 5, 2013), interfered with planning during her scheduled planning time.

In addition to her course load, Megan served as the lead teacher for the Fine Arts Department. As lead teacher this school year, she was called upon to take over musical production rehearsals until the school found a replacement for the Music teacher who left a few months in the year. She also sponsored a Culinary Club and the Art Honor Society, which was involved in a community quilt project for Veteran’s Day.
The teaching environment. Megan taught six periods and saw approximately fifty-five students in those six classes each day. Megan average class size is ten students. Because she was the only Visual Art and Photography teacher, sometimes her classes were combinations of first year art students of more advanced students. For example: “1st period is all Art I; 2nd is Photography; 3rd is AP Art and 1 Art III student; 4th period is Art II; 5th is Art I and 7th is Art I with the 1 AP and some Art III students” (M., Interview 1, September 18, 2013). If she wanted to teach advanced students, she had to accommodate the scheduling constraints of the students’ other courses and take them whenever they had a free period. Because her school had a Fine Arts requirement to graduate, she will have:

…the senior who has waited until the senior year to take that credit and then spends the year saying, “You know, if I don’t pass your class, I don’t graduate.” And I spend the year saying, “I know! Do your homework!” (M., Interview 3, November 5, 2013)

Resources. Megan’s school recently implemented a one-to-one iPad initiative for students and her school was not lacking for resources (see Table 9). As Megan previously mentioned, she was less likely to use technology compared to other teachers at her school, but since every student had an iPad, she was required to make interactive instruction using the devices. To create interactive lessons for her students, Megan developed an iTunes U courses for each art class. (iTunes U is a free application that allowed students to access all course materials online.) She also designed an electronic book (accessed through an application called iBook) to serve as her textbook. She used her iBook to:

…give [students] all the specific Art pieces that they’ll need to know [and] background information…The first unit was called Art from the Earth, so
there’s a video online about how pencils are made, which they were kind of wowed, like pencils are made out of wood and not plastic. I’m old-school. “Look, it’s a pencil! It should be wooden.” So for the iBook, that’s really more the content. (M., Interview 1, September 18, 2013)

The iBook also provided examples of art concepts students needed to learn. She used presentation software to manage or control the subject matter students were allowed to draw for assignments in their sketchbooks:

*Powerpoint* [had] the examples from which they could choose so that I could separate those out and they didn’t say, “Can I draw the Parthenon?” “No. It’s not in the *Powerpoint*. It’s in the *iBook*.” (M., Interview 1, September 18, 2013)

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Megan’s Planning Problem Space

Problem statement. Two things drove the design of Megan’s courses: core concepts and art history. She used her State’s standards to guide the basic core curriculum in her course. Some of the core concepts that her Art I students needed to learn were basic drawing skills such as contour drawing. Her Photography students started out with elements and principles such as using directional lines to create a focal point in a photograph. Additionally, she used art history to present her curriculum in a chronological order. Her rationale for using art history to organize her course content was two-fold. She loved art history and wants her students to know not only the origins of art, but also the origins of the styles of art. An additional consideration was that students at the school were not testing well on the art history section of their AP exams. Megan commented that the “history teacher can’t teach the history of the world and the history of Western art (M., Interview 1, September 18, 2013).

Megan was the only art teacher at her schools and tended to plan in isolation. Although she used to collaborate with other teachers, that did not occur much anymore. For example:

In the past, our Art students have calligraphied and illustrated poems that were written by English students. We have documented Science experiments of Biology students. We took the Photography [to a science class] and they documented the ‘send the goldfish into a glucose coma’ experiment. So when I can find ways to do that I do but it’s often not planning the lesson. It’s planning how we’re going to do this together. (M., Interview 1, September 18, 2013)

Although Megan used State standards to determine the core concepts to teach, she emphasized the “flexibility” she had in how she taught content. Megan mentioned deviating from her regular content for a week to address the art reflected in the school’s
Homecoming theme, *The Great Gatsby*: “[S]o we did art that fit into that so they could understand why their T-shirts looked the way they did” (M., Interview 1, September 18, 2013).

**Design space: Activity structure and routines.** Megan described her planning process:

> Usually what happens is it kind of cooks all week as to what I’m going to be doing the next week and then on about Thursday and sometimes Friday morning I’m getting that done but I really try to get as much [planning] done at school as possible” (M., Interview 3, November 5, 2013).

In her Visual Arts class, Megan usually divided her class period into a ten-minute lecture or presentation of new content and uses the remaining forty minutes for application, during which students were drawing, painting, or otherwise constructing art. While students were creating art, Megan provided one-on-one consultations about students’ art because, “Some students need more coaching and others have plenty of things to say and their frustration is that they can’t make the picture they see in their head come out their hands” (M., Interview 3, November 5, 2013). Her Digital Photography class was structured differently than her Visual Arts because of the content. Instead of sketching or drawing like the Visual Art students, these students choose a location around the school and took a short field trip on shooting days to take photographs.

She described the activities of a typical week, which included three classroom days and two shooting days. Monday was a classroom day for an introduction to the project. On the two days allotted for taking pictures, students choose the locations and the class travels together around the school. For example on a shooting day:

…[students] would need to let me know, you know, where we needed to go so that we could plan the route… So when they come in, you know, I’ll
do the regular 2nd period stuff, read the announcements, blah, blah, blah, and then say, “All right! Tell me where we need to go. Like how we need to organize the day?” (M., Interview 2, October 8, 2013)

Thursday and Friday were reserved for activities such as editing, printing, creating, and presenting their project. Megan suggested to her students that they used the Thursday class, “on the computers, putting the presentation together, doing the cropping and whatever needs to be done.” Each Friday the culminating activity for the project was either a writing analysis or a presentation.

**Design space: Solution path.** Recognizing that technology did not always work in predictable ways, she was flexible in her approach to planning:

If something happens, if something comes up, if I think of something in the meantime, if there’s a better way to do it than what I thought of before based on what I learned 1st period, I’ll do something different 5th and 7th for those Art-1 students rather than [stick with] “I have a plan” (M., Interview 1, September 18, 2013).

To account for “things that are going to be un-plannable,” she preferred to have a plan, but was “not slavishly wedded to it” (M., Interview 1, September 18, 2013). Megan’s flexibility was also evident in her year-to-year plans. In reference to past projects, she said, “We’ve done it a couple of different ways and I’m looking for a new one because I’d like to it differently again this year” (M., Interview 2, October 8, 2013).

Megan’s planning cycle started with the end in mind. With respect to her planning, this referred to “Where do I need [students] to be? What’s a project that can do that?” (M., Interview 2, October 8, 2013). For her students, “Where do I need student to be?” was “communicating meaning,” or “What do you want to say?” (M., Interview 3, November 5, 2013). To make communicating meaning more concrete (“What’s a project
that can do that?”), Megan asked students to write a sentence and connect that sentence to building blocks of art such as line, color, texture, value, and contrast.

The second part of the design cycle involved three options: to provide advice for a choice that encouraged personal style, to provide a set of choices, or removing choice altogether. All three strategies served a deliberate instructional decision. The decision to have a one-on-one consult with the student (or new teacher) was to uncover individual passions. She described the difference in helping a new teacher and students:

So for, to help a teacher, what I would try to do is present you know, four or five different ways to approach it and see which one resonated most with them. With the students, I’m sitting here thinking, “If this were my Art I, my 1st period class, how…” I tend at the beginning not to let them select as much but [use] a limited thing like “Here are eight principles, here are eight elements, you know, pick one of each,” [which] is something that they can manage. (M., Interview 3, November 5, 2013)

Megan said the decision to provide a set of choices was because students “get overwhelmed.” “When they can’t make a choice…it turns into, ‘Well, what do you want me to do?’” If Megan told her students what to draw, she would undermined goal of the assignment (M., Interview 3, November 5, 2013).

Removing choice altogether helped alleviate student anxiety. If student pulled choices randomly out of a hat, students were able to “push against those limitation, which I think spurs creativity as much as having no limitations” (M., Interview 3, November 5, 2013). She attributed the anxiety to the fact that art was a required class and:

They don’t come in thinking, “I’m going to be an artist!” They come in thinking, “Wow! When I was in 5th grade, I did a really lousy drawing of a horse and people made fun of me.” And there’s a lot of anxiety particularly because they probably haven’t been in an Art classroom since that 6th grade … And so if they’re a junior, it’s been five years since they did this at all.
Taking away choice decontextualizes the negative emotions that could be associated with art:

And actually the drawing is even better because then they can say, “I can’t believe I got these two stupid things” and they don’t have to say, “Wow, I made a wrong choice.” (M., Interview 3, November 5, 2013)

The third part of the cycle alternated between practice and feedback. Practice and feedback helped students accomplish the main tenets of Megan’s class:

Think broader. Think more outside. Don’t look for the fastest solution. Look for the most creative solution…. Creativity is important. Be creative. (M., Interview 2, October 8, 2013)

In Visual Arts, student practice daily by drawing in their sketchbooks. Digital Photography students had several shooting days a week to perfect digital compositions. Megan’s strategy for teaching creativity was simple; it involved “Just making them do it” (M., Interview 2, October 8, 2013). After students complete assignments, Megan and her students provided feedback on each other’s work:

We have group discussions. Everybody comes together… and we talk about what you did and what you could do better… “Remember the picture you took last week of the moth on the screen? Remember how that was placed and you did this? And what if you put your face here and did this and blah-blah-blah?” So there’s a lot of verbal processing that goes on… And then, “Okay. Go do it again.” … “Now having seen what we did yesterday, what can you do now to push those things just a little bit more?”

Megan also had students reflect on their own work by writing on a weekly basis. The assignments started out with a formal analysis: “Tell me how you used line. Tell me how you used repetition. Tell me how you used contrast” (M., Interview 2, October 8, 2013). Over the course of the year as students developed a style, the writing was more reflective:
“Why did you choose that image? What is it about this one that spoke to you the most? Why do you think it’s the most successful given this? What would you do next time if you had to it over again or if you took that picture again?” Reflection was an important element in Megan’s class because it help student develop creativity.

**Goal state.** Megan was required to turn in weekly lesson plans. The required areas were lesson name, objectives, activities, materials, homework, and assessments. She turned in what she described as vague plans, providing short phrases such as: “OBJECTIVE: Continue work on assigned project… HOMEWORK: Work on project as needed…ASSESSMENTS: Observation” (M., Email communication, February 6, 2014). Most of her effort toward planning was in her *iTunes U* class, which housed all her assignments, teaching materials, and student materials.

![Megan’s Teacher Planning Problem Space](image)

*Figure 15.* Megan’s *teacher planning problem space*. This model is summary of Megan’s planning. Images, © 2014 Common Craft®.
Megan’s teacher planning problem space. Megan’s private school followed a traditional curriculum that was guided by Common Core State Standards for teachers (see Figure 15). She taught several levels of Visual Art and Digital Photography on a regular schedule that did not change much from day-to-day. Her school had a one-to-one iPad initiative and she used the device daily for teaching and learning. Her problem statement tended to be process-oriented and she did not plan with others teachers. Megan created a flexible structure of activities and routines using her experience and knowledge. She described a typical Visual Art lesson as series of two main activities: a short teacher led introduction to new concepts and independent student application of those concepts. She was not afraid to ask the technology support people at her school for help. Megan’s solution path was content focused and characterized by flexibility, troubleshooting, student creativity, and reflection. Her goal state was her presentation for her students and a required written lesson plan.

Ronan

Mathematician

Ronan was in his fourth year of teaching at an International Baccalaureate candidate school in the suburban Southwest. He taught Pre-Algebra, Algebra, Geometry, and Algebra II to students in grades 7 – 10. At age 28, he held a Masters degree. Ronan entered teaching from the corporate world. After graduating with an undergraduate degree in business and working a few years as an investment banker, Ronan decided to become a teacher. In reference to teaching, he said: “I really, truly enjoy my job—and
I’ve had whether you call it the blessing or the curse of being in a job that I truly despised—I really, I enjoy every day” (R., Interview 1, September 4, 2013).

In addition to the PBS award, Ronan had been awarded several other accolades. He was voted as a top ten innovator in a nation-wide contest, awarded a several grants for creative educational projects, and honored as Teacher of the Year by a state alternative certification program. His motivation for entering the Teacher Innovation Awards was simple: “I had already done the work” (R., Interview 3, November 4, 2013). The whole entry process took him about an hour and the benefits far outweighed the time invested:

… So if you can spend an hour [to enter the contest, that resulted in] expanding your professional network or increasing your experience or skills, I think that’s a pretty easy ask…[T]he winners received an all-expenses paid trip to an Innovation Conference in Detroit—and that just sounded like something I’d love to do—getting to learn from nine other colleagues who also won the 1st place prize. And it did not disappoint. It was an absolutely tremendous conference.

Ronan thought that using technology in his classroom was important in all phases of teaching; teach with it, learn with it, and assess by it. With respect to the purpose of educating students with and about technology, “[i]f we’re increasing productivity in the workforce with technology, we should increase productivity in the classroom with technology” (R., Interview 1, September 4, 2013). In addition to being efficient, he said that technology also increased the level of student engagement because students’ “side conversations go down and I really feel like [students] immerse themselves in the content or the skills that they’re learning.” He was not discouraged by technical difficulties:

I’m really frustrated that I have to type a password into our school’s iPad so I can load the software. I mean that was such a pain. I had to individually do that for 25 iPads but afterward; I just got the most incredible lesson out of it. So despite the fact that I really disliked those 45-50 minutes while I was manually inputting the passwords so I could
Ronan had a “healthy risk appetite” and was “not afraid to try” (R., Interview 3, November 4, 2013) in reference to learning about and teaching with technology. He claimed that, “if I see a good idea out there about education and technology, I’ll try it out.” His risk-taking behavior has taught him that:

…not everything works perfectly initially but if you stick with it, you find ways to make your life easier and to improve student engagement and performance utilizing technology. Like I said, you have to really do some trial and error initially because you’re paving new ground. So you can’t really expect things to work perfectly initially. But if you stick with it, you’ll figure it out and it’ll make life a little easier.

**Ronan’s Planning Task Environment**

**The school environment.** Ronan’s school was a public, tuition-free charter school funded like a public school. It was open to all students living within the county in which the school resided. The school was an International Baccalaureate (IB) candidate school for the high school level.

Ronan taught middle and high school students at a school that served a little less than 1000 students total, with approximately 225 students in grades 7 – 10. Students at Ronan’s school were on an A/B block schedule, meaning that they attended four classes on an A day and four different classes on B day for 90 minutes each. His scheduled planning period was from 2:15pm – 3:45pm everyday except for Wednesdays.

Every Wednesday, Ronán’s school was on an early release schedule so that teachers could participate in professional development activities and attend to
administrative business. He described a typical Wednesday schedule for 3-hour session as follows:

From 2:00 p.m. to 5:00 p.m., but we’re not meeting the full three hours. Usually it’s 1 hour of that 3 hours [that] is utilized for cooperative planning time…There’s usually an hour’s worth of administrative tasks….And then the last hour is usually about at-risk students. (R., Interview 3, Nov. 4, 2013)

During the cooperative planning sessions, Ronan and his coworkers shared lesson ideas, provided feedback on lessons, and read each other’s lesson plans to see how to incorporate concepts into their own lessons. They also received feedback from their principal. Ronan routinely arrived at school early and stayed at school until his planning was completed because “I don’t like working at home… I feel like that’s [home] some pretty sacred time.”

Ronan referred to his administration as extremely flexible in the planning demands they placed on teachers. Teachers were required to turn in monthly unit plans that provided only broad outline of topics rather than details of daily or weekly lesson plans. The IB lesson plan template was “based on inquiry and global connections and as a result, there [are] a lot of things that aren’t really sound, that don’t sound mathematical, within my unit plans” (R., Interview 1, Sept. 4, 2013). Instead of starting with a broad unit objective, his planning template starts with identifying key concepts and situating the lesson in a global context. The body of the lesson is framed in terms of inquiry goals. The statement of inquiry is similar to a lesson objective and the rationale behind the factual and conceptual questions are to prompt students to move from concrete to abstract concepts in a lesson. The debatable question encourages students to evaluate new
Ronan was thankful that he was not required to submit daily plans, which he felt would limit his creativity.

…it’s tough for me to plan a lesson a month away because I know that there is going to be something that comes along that is going to supersede whatever I had thought about a month ago. So for me, I want the content the day ahead of time … and then I want to have some creative time to imagine how to reflect this technologically or otherwise into the lesson where it’s fun for the students.

Ronan’s written plans were a general outline of a lesson.

After school, Ronan sponsored both the Entrepreneurs Club and the Distinguished Speakers Club. Along with his teaching duties and club responsibilities, he served as what he described as “lead for technology” in his school (R., Interview 1, September 4, 2013). As a technology lead, “in terms of professional development and teaching other teachers how to use technology appropriately, I do quite a bit of that and then for troubleshooting, I probably roughly split those duties with our systems administrator.”

When Ronan was not teaching classes or helping teachers in his school he liked to keep busy by participating in profession development opportunities, working for an educational technology company, and creating online course content.

The teaching environment. Ronan’s average class size was 20 students and he saw approximately 60 students a day. His classroom was rather unique:

My room is a little odd-shaped. It’s triangular shaped… And there are, our desks are actually really cool. They’re my favorite desks I’ve ever seen in terms of student desks. They are triangular. So your body sits at the base of the triangle… And what this allows you to do is very easily get into pods. (R., Interview 1, September 4, 2013)
Ronan described the students in terms of a general class cultures. His eighth grade students had “a very respectful yet playful personality and they want to have a good time, they want to have fun and they respect each other, they respect me the teacher.” The ninth graders in his Geometry class were more serious than his eighth graders and he said, “I want them to inject more energy and it just, it just doesn’t happen.” His tenth grade students were “the most difficult to wrangle,” and “probably my top 2 most challenging class[es] I’ve ever taught.”

**Curriculum.** The IB curriculum emphasized an international perspective that encouraged students to participate in creative and service-oriented activities ("Information for Parents," 2014). The goal of the program was for learners to become: inquirers, thinkers, communicators, risk-takers, knowledgeable, principled, caring, open-minded, well-balanced, and reflective ("IB Learner Profile," 2014). Student applied to attend and put on a wait-list if more applications were made than spaces available. In addition to the IB curriculum, Ronan was required to follow his State’s standards to determine what Algebra I, Geometry, and Algebra II content to teach at a particular grade level. Key words from the standards included understand, communicate, make inferences, and draw conclusions about mathematical concepts. All of his courses were subject to state testing.

**Resources.** Ronan had several technology devices (see Table 10) at his disposal including graphing calculators, a few computers in the classroom, a shared class set of laptops, an interactive whiteboard, and a shared class set of iPads. Out of the devices listed, he most frequently used the interactive whiteboard and iPads. One example of
Table 10
Survey results of Ronan’s technology resources and frequency of use

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Available</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Computers located in your classroom everyday</td>
<td>1-5</td>
<td>Often</td>
</tr>
<tr>
<td>Computers that can be brought into your classroom</td>
<td>21-25</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Computers in the computer lab</td>
<td>No</td>
<td>Never</td>
</tr>
<tr>
<td>LCD or DLP projector</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Video conference unit</td>
<td>No</td>
<td>Never</td>
</tr>
<tr>
<td>Interactive whiteboard (e.g., SMART Board, Activboard)</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>Classroom response system</td>
<td>No</td>
<td>Never</td>
</tr>
<tr>
<td>Digital camera (still or video)</td>
<td>Yes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>MP3 player/iPod</td>
<td>Yes</td>
<td>Rarely</td>
</tr>
<tr>
<td>Document camera</td>
<td>No</td>
<td>Never</td>
</tr>
<tr>
<td>Handheld device (e.g., iPad, iPod, Windows Surface,</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>other tablet)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

using his interactive whiteboard was to invert an image from an online article to demonstrate absolute value. He elaborated:

I’m going to overlay that rotated image and then layer a coordinate plane on top of that. Students are going to be looking at a building with a ray of sunshine making a “V” with a coordinate plane. And then I’m going to ask them on their calculators, because we have graphing calculators, to type in the parent function of an absolute value, which is \( y = |x| \) and then they’re going to see it. It looks exactly like what they see on the screen (R., Interview 2, September 24, 2013).

iPads were also useful for graphing activities in Ronan’s class. He installed an application called *Draw Free* and took screen shots of isometric dot paper for his students to used to draw three-dimensional objects.
Some additional technology resources that Ronan regularly used in class were Google applications and Twitter. He encouraged his students to create student Gmail accounts and used Google Forms to facilitate online assessments. Twitter provided a professional learning tool for Ronan and several of his students followed him on the social media site.

**Ronan’s Planning Problem Space**

**Problem statement.** Ronan taught courses that emphasized processes and problem solving. He only used the teachers’ editions for his courses to design his syllabus, or to organize the topics he teaches during the school year. He preferred to:

…create my own problems and use PDFs of class notes we make together at school to help students have access to material. I generally find textbooks an expensive and less-efficient resource vis-à-vis other public, free options. (R., Email communication, January 30, 2014)

Ronan took a real-world approach to teaching his content. He was “a firm believer that creation is the highest form of content mastery” (R., Interview 1, September 4, 2013) and challenged his students to generate good math problems their own. He thought:

…Math gets short-handed a lot because people do think that there’s one way, there’s one correct answer but we find in nearly every lesson a different way to do something. And yeah, you might come out to a “right answer” but that doesn’t mean that’s there’s only one way to get it and that doesn’t mean that there’s only one representation of that correct answer (R., Interview 2, September 24, 2013)

Preferring to use real-world examples, he often searched Twitter for ideas that he could relate to mathematics concepts. For example:

… I read through my newsfeed today and I saw that there’s a building in London that because of its geometric shape, when it reflects light, it
Ronan thought his enthusiasm for the content was apparent whether or not he taught using traditional methods or more innovative ones. When he was in front of student, whatever the content, it should come across as “…the best thing I’ve ever taught and you should love it too” (R., Interview 1, September 4, 2013). He not only approached each lesson with this attitude, but also took the additional time to create his own problems for student practice. “[W]hen I create the problems, I have a better sense of how… difficult they are, what the answers are, how the process works.”

**Design space: Activity structure and routines.** Typical class sessions taught by Ronan’s appeared traditional in the sequence of activities. He started class by engaging the students through questioning to access their prior knowledge and then presented new course content. The new course content was usually delivered through an example of a real world application of the relevant math concepts. After this brief teacher-directed activity, students were provided with the opportunity to apply their knowledge both independently and collaboratively in randomized cooperative groups. Ronan ended lessons by bringing the student back together as a whole group to address the learning objectives, summarize the lesson, and handle any related administrative tasks.

Where Ronan’s activities departed from the traditional was in how he wove technology into both teaching and learning. For example, referencing prior knowledge involved reading an article outside of class via Twitter: “I’ve tweeted this article out so
my guess is probably half of the students will have read it already because the students all follow me and I follow them” (R., Interview 1, September 4, 2013). Ronan asked those students who read the article to summarize it during class for what he called “psychological reasons,” meaning that “because then the students who didn’t read it or who aren’t active on Twitter will be like, ‘Oh. I’m missing out. I got to start getting in on this!’” The teacher-directed part of his lesson was facilitated through his interactive whiteboard on which he modeled what students were required to do. Because Ronan was “fine with ambiguity,” he said:

I don’t think that every lesson needs all directions spelled out in a formative sense. So if we’re doing formative assessments that aren’t going to impact their grade, I actually love the ambiguity because it forces them to think and ask questions and collaborate in order to come up with an appropriate response.

Students used iPads to complete in-class assignments and used Google Forms to complete homework.

He described anything to do with the management and organization of his classroom as simple and straightforward. For example:

I feel like, to be prepared for class in college, I didn’t really need anything. But to be prepared for some of these high school courses that they’re taking, they have to bring loads of materials and a book…I understand in some cases where that’s important but I would rather them just come into class and have class be so simple that from a classroom management perspective, that there’s nothing else on their mind. (R., Interview 2, September 24, 2013)

Ronan’s students did not need to bring paper and pencil because “dry erase markers are everywhere…just write on your desk.” His system for understanding homework due dates was easy, students were assigned homework every day and “it’s due the next time I
see you.” Ronan explained that his reason for streamlining routine tasks in his class was to avoid losing instructional time to “ask and answer repetitive questions—I mean that stuff just drives me insane and [I like] being able to eliminate that by [using] simple, procedural common sense.”

**Design space: Solution path.** Ronan was a self-described *just-in-time* planner. In terms of ideas for instruction, Ronan said, “so much comes to me and things just sing to me. And I don’t know when they’re going to arrive, so I don’t want to have like a very set in stone method of going into a lesson” (R., Interview 1, September 4, 2013). Ronan’s thinking was that if he were not flexible, he might miss out on planning a creative instructional opportunity for his students. He preferred to plan the morning of or day in advance and elaborated on his planning process:

I know exactly the content that I’m teaching that day but I don’t know how I’m going to spin it… part of the reason that Japanese auto manufacturers were able to get a significant edge on the Americans is because they created something called *just-in-time* inventory. And they were able to throw out machines with very limited inventory and kept it very lean. And that’s how they were able to offer lower prices and I was thinking that I’m kind of like a *just-in-time* teacher [in] that I know what I’m going to do, I’m going to you know, instead of making a car, I’m making a lesson.

This *just-in-time* planning allowed for a “creative spark” and made class topics relevant for his students. Ronan’s design space for planning also occurred year-to-year, lesson-to-lesson, and within-a-lesson.

A year-to-year design space involved changing the topic of a lesson to make it more relevant or current. One example of a year-to-year cycle of design was a Geometry lesson on parallel lines:
And I did this lesson 3 years ago... We did it with U.S. cities and it worked out really well. They liked it! It was an interesting way to look at it—instead of looking at esoteric angles, they’re looking at geographical cities... I decided to make this more of a multi-cultural experience by including cities in the Middle East. So I just changed the section of the world that we’re looking at. (R., Interview 2, September 24, 2013)

In addition to making the Geometry lesson more multi-cultural, changing the location to the Middle East helped students remember the content because:

A lot of [students] haven’t taken a firm look at a Middle East map ever. So trying to pronounce some of these city names, equating them to Geometry, and relaying what’s happening over there in terms of conflict I think is going to be something that’s very sticky... It won’t fall out of your head because you’ve got an emotional attachment to that knowledge. (R., Interview 2, September 24, 2013)

Another example of Ronan’s year-to-year planning was using Twitter as an educational tool with his students. The first step in his implementation process was to “… try it myself, and you can’t anticipate every question or every type of bug or every malfunction or every deficiency within your technological product but you can do probably… 80-90% on your own” (R., Interview 1, September 4, 2013). The second step was to “beta test” or pilot the process with one class of students, which served as a controlled way to rollout technology initiatives within Ronan’s classroom. He said:

There [are] just as many positives that you could have with Twitter—you could have equal negative arguably. So… I piloted the program with 23 of my students, just one class and so far it’s gone pretty well. There [have] been a lot of things that I didn’t anticipate happening that have been positives but no real negatives to date, nothing that would keep me from implementing it in other classes.... We’re all learning [from this experience] and I’m going to do this pilot test for the entire year and continue integrating it and seeing what works and what doesn’t and then hopefully we’ll roll it out to, like I said, all 140 of my students next year.
His rule of thumb for deciding to pilot test any technology in his class was “if the worst thing is that I get fired, then I pilot test it.”

Lesson-to-lesson planning occurred during one school year and allowed Ronan to not only work out the kinks, but also perfect a process. Again, he implemented a beta test to implement what he called robo-grading. *Robo-grading* was a way to use technology to grade multiple-choice questions. He explained:

100% of [students’ homework] exists on my website but 70% exists in the form of a *Google Form*. So they open up a PDF and there’s a corresponding *Google Form* and I’ve written all of these lessons with the individual multiple-choice answers. (R., Interview 1, September 4, 2013)

Ronan used *Google Forms* as an online assessment tool that immediately graded student work and sent their results to a spreadsheet. His rationale for this process was:

…there came a point last year… [where if an answer was] right or wrong, I just [did not] provide that much value grading it… [For questions that were] binary questions, it was frustrating because I knew that… it was the least efficient use of my time [for grading]. So… I piloted this again because I didn’t know if this was going to end in tears or not.

Integrating *robo-grading* “streamlined my processes so well and now I have so much more time,” and “it ended up being wildly successful.” His routine for working more complex problems or free-response questions was during class time.

In *within-a-lesson planning*, Ronan makes adjustments based on his students’ abilities. An example of changing a lesson during a lesson was by changing the difficulty of a problem, which he and his students referred to as *spiciness*. The term spicy came about as:

…one of the student’s ideas—[students said,] “That was a jalapeno,” and I said, “No, that was more like a ghost pepper. That… thing would bite your head off.” (R., Interview 1, September 4, 2013)
How he redesigned during a lesson was to decrease:

… the spiciness of the problems on their desk and I do that ad hoc … it’s easy in math. On their desks, I can [make changes] very easily, because it’s dry erase; I can take my finger and I can erase the difficult part. It’s so easy. And that’s what I do, I look at them and I can tell if they’re struggling and if they’re put off. I say, “Hey, let’s try this” and I just remove a piece of the complexity and so it’s kind of like the concept of the Khan Academy where people should progress at their own pace. So I start at the most difficult but possible problem, one that I think at most one or two kids can get individually and then I adjust downward from there. (R., Interview 1, September 4, 2013)

**Goal state.** Ronan was required to turn in lesson plans monthly. In class, he wrote the objective on the board but he did not like to write much else of his daily plans. Instead:

…in terms of writing anything else down, I carry it mostly in my working memory because I’ve thought about it so recently that I’m not really, I don’t have a chance to forget it, usually. (R., Interview 1, September 4, 2013)

*Figure 16.* Ronan’s teacher planning problem space. This model is summary of Ronan’s planning. Images, © 2014 Common Craft®.
Summary. Ronan’s public charter school followed an International Baccalaureate curriculum that was guided by State Standards (see Figure 16). He taught mathematics on a regular schedule that did not much change from day-to-day. Ronan preferred to use an interactive whiteboard and iPads for teaching and learning. His problem statement tended to be process-oriented and he did not regularly plan with others teachers. Ronan’s experience and knowledge contributed to a flexible structure of activities and routines for his lessons. He described a typical lesson as series of three main activities: accessing prior knowledge that led into a discussion of new content, an individual or small group application of new concepts, and a whole group or small group discussion of the application. Characterized by troubleshooting, student creation, and flexibility, Ronan’s solution path was content focused, however, he usually discovered real-world applications of mathematics using social media. His goal state was mental plans for daily lessons and a required monthly written plan.

Summary of Experts’ Teacher Planning Problem Space

The teacher planning problem space was made up of external influences on planning that occurred in the planning task environment as well as mental process that took place in the planning problem space. The following section summarizes the results according to the conceptual framework.

Planning task environment.

According to researchers (e.g. Brophy, 1982; McCutcheon, 1980; Sardo Brown, 1993), teachers' planning involves a complex, simultaneous juggling of information about students, curriculum, class size, school practices, and policies; elements out of a teachers
direct control. The planning task environment represented this complex juggling of information and the point at which the teacher tackled the instructional problem presented before them.

**School environment.** In the school environment, factors were institutional, over which teachers had little to no control. These factors included school type, location, curriculum taught, number of students in a school, class size, scheduling, responsibilities, and policies. School types ranged from public to private and the school model dictated the kind of curriculum taught to students. One participant taught at a Southern private school with a Christian affiliation that followed the traditional college preparatory curriculum. The remaining five participants taught at public schools located in the Midwest, Southeast, and Southwest.

Of the three public school types, two were traditional, one was a magnet school, and one was a charter school. Magnet and charter schools were designed to create school choice for parents and students. In a magnet school the curriculum is enriched by additional course offerings emphasizing a particular career path, but emphasizes a traditional college preparatory education. The charter school was also an International Baccalaureate (IB) school. IB is a curriculum that emphasizes global thinking through inquiry and intercultural connections. Table 11 summarized individual school information.
Table 11  
School information

<table>
<thead>
<tr>
<th>Participant</th>
<th>Location</th>
<th>Type</th>
<th>Grades</th>
<th>Students</th>
<th>ACS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandon</td>
<td>Rural Southeast</td>
<td>Public, Traditional</td>
<td>6 – 8</td>
<td>625</td>
<td>25</td>
</tr>
<tr>
<td>Felicity</td>
<td>Suburban Midwest</td>
<td>Public, Traditional</td>
<td>K – 5</td>
<td>505</td>
<td>24</td>
</tr>
<tr>
<td>Henry</td>
<td>Suburban Southwest</td>
<td>Public, Magnet</td>
<td>9 – 12</td>
<td>2500</td>
<td>28</td>
</tr>
<tr>
<td>Laurie</td>
<td>Rural Southeast</td>
<td>Public, Traditional</td>
<td>K – 6</td>
<td>916</td>
<td>27</td>
</tr>
<tr>
<td>Megan</td>
<td>Rural Southeast</td>
<td>Private, Christian</td>
<td>K – 12</td>
<td>950</td>
<td>14</td>
</tr>
<tr>
<td>Ronan</td>
<td>Suburban Southwest</td>
<td>Public, Charter, IB</td>
<td>K – 10</td>
<td>995</td>
<td>25</td>
</tr>
</tbody>
</table>

Note: ACS = Average Class Size

Whether the curriculum was traditional or IB, all participants had either State or National standards to follow, which guided the scope of curriculum to teach and the sequence in which it was taught. The standards also dictated the course content topics but not the individual activities planned by the participants. The art teachers, Megan and Felicity had more “freedom” (F., Interview 2, September 23, 2013) and “flexibility” (M., Interview 1, September 18, 2013) in the way they taught their content. Henry and Ronan followed State standards and their course content was subject to State testing. Laurie and Brandon had National standards outline by the AASL and ISTE respectively. Participants used the required standards to determine what content to teach.

Although Becker (1994) associated smaller class sizes with exemplary technology integrating teachers, in this study, class size did not interfere with the participants’ exemplary innovative practices using technology. The participants who taught in public school had at least 24 students in each class and they did not mention the number of students as a limiting factoring for technology integration.
School schedules. Teachers rarely get to choose their teaching schedule. Teaching schedules, including planning time, are often an administrative decisions. According to McCutcheon (1980), scheduling, especially time allocated for planning, was an important factor that influenced teachers’ planning decisions. The participants’ schedules fell into three categories: regular, semi-regular, and irregular.

Regular schedules referred to a set of fixed schedules dictated by school administrators that were consistent throughout the school year. Megan, Henry, and Ronan were examples of regular schedules. One common preference of these three teachers was that they completed their planning at school rather than take work home. Often, time scheduled for planning or a lack of planning time is cited as a barrier for technology integration (Ertmer, 1999; Groff & Mouza, 2008; Hew & Brush, 2007). Noticeable, however, among all three teachers with a regular schedule was that they did not mention a lack of time for planning in their schedules. The researcher perceived this as a benefit of having a regular schedule. Teachers were better able to organize other duties and responsibilities around a consistent schedule and budget their limited time accordingly. Because these experts were able to plan either before school or during their planning time, there were no perceived issues with planning on a regular schedule.

A semi-regular schedule referred to schedules that were determined by a fixed school schedule but did not include a planning period on every day and were subject to change based on events that were not regularly scheduled. Felicity’s art classes were on a semi-regular schedule because the schedule could be modified with little or no notice and she did not have a planning period every day. Like the participants who had regular schedules, Felicity preferred to plan at school. She, however, was much more conscious
of time, not only for planning, but time in general. This was likely due to the limited amount of time she was able to spend with students: once a week for either 30 or 45 minutes.

*Irregular schedules* were determined by the participant rather than dictated by school administrators. The two participants with irregular schedules were in support roles, rather than traditional teaching roles in their school. Brandon preferred to plan during the school day and Laurie planned at home. Laurie used her time at school to do things she could not take home, such as cataloguing, shelving, and ordering media. The main difference between the ways in which Laurie and Brandon described their day, was that Laurie was much more time conscious than Brandon. While both their schedules were dependent on other teachers’ schedules, Brandon was free to drop in and out of classrooms, whereas teachers in Laurie’s school came to her. Depending on the teacher demand for visiting the Media Center, she tended to have no planning time during a school day.

Researchers (e.g. Earle, 2002; Groff & Mouza, 2008; Zhao et al., 2002) advocate support mechanisms such as technical and pedagogical support to promote technology integration in schools. Educators in a support role on irregular schedules provided the type of support, which allowed for them to be both flexible and available for teachers’ needs. Depending on the expectations that either they placed on themselves or the expectations placed upon them by their school environment, Laurie and Brandon, the participants with irregular schedules, were able to adapt and accommodate some or all of their time to serve others.
Table 12
Scheduling categories, lesson planning time, and lesson planning preference

<table>
<thead>
<tr>
<th>Participant</th>
<th>Schedule</th>
<th>Planning</th>
<th>Actual lesson planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandon</td>
<td>Irregular</td>
<td>None</td>
<td>Throughout school day, scheduled as needed</td>
</tr>
<tr>
<td>Felicity</td>
<td>Semi-regular</td>
<td>Varies</td>
<td>Before school</td>
</tr>
<tr>
<td>Henry</td>
<td>Regular</td>
<td>100 min</td>
<td>During scheduled planning time</td>
</tr>
<tr>
<td>Laurie</td>
<td>Irregular</td>
<td>None</td>
<td>At home</td>
</tr>
<tr>
<td>Megan</td>
<td>Regular</td>
<td>50 min</td>
<td>During scheduled planning time</td>
</tr>
<tr>
<td>Ronan</td>
<td>Regular</td>
<td>90 min</td>
<td>Before school</td>
</tr>
</tbody>
</table>

Note: Planning time scheduled is in minutes per day by the school administration. Actual lesson planning = the time during which teachers actually plan their lessons.

The experts’ schedules were regular, semi-regular, or irregular (see Table 12). Scheduled planning time ranged from zero to several hours. The classroom teacher with zero planning time during the school day came early to school to plan before school started.

The educator in the instructional technology support role, who had no planning time during the day, preferred to plan at home. The three types of schedules had benefits and issues associated with them. Irregular schedules had the greatest benefits but also the biggest issues. They allowed for flexibility and availability but also were subject to over commitment leaving no time for planning during the school day. Semi-regular schedules were the most unpredictable and either placed more demands on a teacher’s time during the school day or opened up an unexpected period of time for planning. Participants on a regular schedule did not express concerns regarding a lack of planning time during the school day. Table 13 summarized the scheduling categories, benefits, and issues.
<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics</th>
<th>Benefits</th>
<th>Issues</th>
</tr>
</thead>
</table>
| Regular      | • Followed a consistent pattern on a regular basis  
• Planning time did not vary per day  
• Determined by school administration | • Predictable  
• Planning accomplished during or before school | • None                                               |
| Semi-regular | • Followed a somewhat consistent schedule but is subject to change with or without notice  
• Scheduled planning time varies per day  
• Determined by school administration | • Unpredictable – created more planning time  
• Planning accomplished during or before school | • Unpredictable – created less planning time |
| Irregular    | • Followed self-imposed schedule  
• No formally scheduled planning time during the day  
• Determined by individual, depended on other people’s schedule | • Flexibility  
• Availability  
• Planning time created by individual during school | • Over-commitment  
• Planning not created by individual during school |

According to the literature, a lack of time for both planning (McCutcheon, 1980; Sardo Brown, 1993; Yildirim, 2003) and technology integration (Ertmer, 1999; Groff & Mouza, 2008; Hew & Brush, 2007) was cited as a major problem for teachers. The participants in this study who mentioned lack of time were at the elementary school level and this lack of time was not in reference to planning but instead to time in class teaching the students. Laurie and Felicity had 30-minute and 45-minute class sessions with their students. Both their content was considered a non-core course similar to electives. Their focus was on making sure students did not lose instructional time and when they did not have time to plan during the instructional day they made arrangements to either come to school early or take work home.
Responsibilities and school policies. According to Sardo Brown (1993), the goals of the school administration, the principals' planning requirements, and administrative policies have been demonstrated as profoundly influencing planning. These responsibilities and policies determined by the study participants’ administration in addition to teaching courses created time constraints for planning instruction. Responsibilities fell into categories of school requirements, leadership duties, extracurricular sponsorships, and outside school engagements. How school policies were enforced or interpreted by administrators contributed to perceptions about the culture of support at the participants’ respective schools. Policies such as turning in lesson plans, discipline, technology, and grading were mentioned as areas in which the study participants felt their administration was supportive. According to Groff & Mouza (2008), school administrators exerted a considerable influence on social structure and culture, establishing a venue for the success or failure of instructional initiatives. The participants in this study indicated that they worked in a culture that supported their needs.

Megan and Ronan were required to turn in lesson plans: one on a weekly basis and one on a monthly basis respectively. Ronan spoke favorably of his administration’s lesson plan requirements: “If I had to write lesson plans every day, that would be a tremendous misuse of time in my opinion where I could be providing value to other places” (R., Interview 1, September 4, 2013). According to Ronan, his administrators did not micro-manage teachers and were “very flexible [and]… [they] go in to classes to make sure that you’re using good strategies. So there’s a lot of trust.” (R., Interview 1, September 4, 2013). Megan did not provide a prospective on her administration with respect to lesson plans, but did mention that her principal was supportive in terms of
discipline. Henry stated, “I’m very blessed to not only have a school that supports technology but also to have a school that supports me and my ideas” (H., Interview 1, September 4, 2013). Brandon’s principal allowed him the freedom to “establish what my position did” in terms of designing school-wide strategies for technology integration and he thought his work in this role contributed to “a culture of not being afraid if something doesn’t work right. We kind of adapt and overcome as they say” (B., Interview 1, September 12, 2013). In Felicity’s class, grades were not assigned officially on report card, but her administration was supportive of her more authentic alternative assessments for students. Students’ work was posted on an online digital art gallery. The gallery publically displayed their work, which allowed people outside of the school to follow students’ artwork and provide comments; creating a dialogue about art.

The participants in this study served as leaders in some capacity in their school. Three participants described themselves as the go-to person for technology assistance. One participant was asked to represent art educators at a national conference on innovation in education. Another participant was head of her department and had to take “charge of the school musical” because the choir and drama teacher was pregnant and “her maternity leave starts a month before the musical” (M., Interview 2, October 8, 2013). One participant preferred most experienced to the term lead teacher because there was another person in the official role, but he took the lead in the practical aspects of conducting laboratory experiments: “So I have a class set, I do a lab, then another teacher will just take my set-ups and take it to their classroom and then they will reproduce the lab with their students” (H., Interview 2, October 4, 2013).
Additional responsibilities included sponsoring extracurricular activities and engaging in outside school activities. Brandon and Laurie sponsored book clubs, while Megan sponsored a club called Culinary Arts and the Arts Honor Society. Ronan also sponsored two organizations: Entrepreneurs Club and the Distinguished Speakers Club. Felicity conducted professional development after school and on the weekends and Henry visited elementary schools to get students interested in science.

**Teaching environment.** Within the teaching environment, teachers encountered factors such as the physical classroom, class size, students, and resources. The following is a summary of the participants’ teaching environment.

**Classroom.** Brandon used the media center as his classroom and the other five participants’ had at least one classroom in which they could design a physical space for student learning. Megan had three classrooms: an art studio, a computer lab for Digital Photography, and classroom for ceramics. They had parameters such as the furniture or interesting room shapes but could bring in outside objects that created an atmosphere that reflected their personality. For example, Felicity filled her room with silly toys and a life-sized replica of her. Laurie had a big rug with grid lines on it to group students at the beginning of a lesson. The secondary teachers talked less about items in the room but brought their personalities into the teaching environment in different ways. Ronan did not care if dry erase markers were all over the floor as long as student knew where to find them. Additionally, several participants spoke about their enthusiasm for the content that they brought to the classroom, which indicated that it did not matter where they taught, learning could still occur.
Resources. Participant described resources in terms of human, non-technology based, and technology based. Non-technology resources were items like dry erase markers, paper, and art supplies. Human resources consisted of parent volunteers, subject matter experts, or technology support that assisted in classrooms. The two elementary school teachers, Felicity and Laurie asked parents to help in their classroom by preparing artwork for display or assisting Kindergarteners with keyboarding skills. Henry asked a police officer to visit his classroom to demonstrate waves using a radar gun. Megan often called upon the technology support in her school when she encountered difficulties. Brandon served in an official role for instructional technology support while Ronan served in an unofficial one. Consistent with Zhao et al.’s (2002) finding, the experts in this study knew the “social dynamics of the school, were aware of where to go for what type of support, and were attentive to their peers” (p. 494).

Participants in this study did not indicate that they were lacking technology resources to use in their teaching and learning (see Table 14). The participants each had access to a class set of iPads – one teacher taught at a school with a one-to-one iPad initiative. They had either a computer for each student in their classroom or access to a laptop cart that could be brought to their classroom. One participant has a one-to-one laptop initiative at his school. Five of the six participants had an interactive whiteboard and all had access to LCD projectors and digital camera. Two participants won their interactive whiteboards by entering contests. As Ertmer et al.’s (2001) findings suggest, if these experts were lacking in resources, they found or invented ways to obtain them.
Table 14
Summary of participants’ resources availability

<table>
<thead>
<tr>
<th>Resource</th>
<th>B</th>
<th>F</th>
<th>H</th>
<th>L</th>
<th>M</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Computers located in your classroom everyday</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Computers that can be brought to classroom (laptops carts)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Computers in the computer lab</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>LCD or DLP projector:</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Video conference unit</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Interactive whiteboard (SMART Board, Activboard)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Classroom response system</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital camera (still or video)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>MP3 player/iPod</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Document camera</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handheld device (iPad, iPod, Windows Surface, tablet)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: B = Brandon, F = Felicity, H = Henry, L = Laurie, M = Megan, R = Ronan

Planning Problem Space

Understanding the planning task environment was an important precursor to examining the planning problem space that participants constructed. This section represents a summary of the experts’ planning problem space presented according to elements experts encountered as they negotiated that space.

The planning problem space had three subsections: problem statement, design space, and goal state (see Figure 7). Teachers were given curriculum standards to teach, but devised their own problem statement, or an interpretation of what to teach and how best to teach their content by considering factors from both the school and teaching environment. The design space included two main parts: structures of activities and routines as well as a solution path. When the lesson content was ready for implementation, teachers achieved a goal state.
**Problem Statement.** According to Hadley & Sheingold (1993), problem-solving for technology integrated instruction required a flexible approach to their teaching with technology, at least five years of experience teaching with technology, and emphasized a student-centered learning environment. All six participants mentioned flexibility as part of their problem-solving process. Contrary to Hadley & Sheingold’s (1993) five-year rule, one participant (Ronan) had less then five years experience in the classroom but still demonstrated innovative practices. The degree of student-centered learning depended on the age of the learner. The youngest learners had choices within activities but the processes tended to be guided by the teacher with adjustments for students’ abilities. For example, Laurie described an upcoming digital storytelling activity for Kindergarteners. She said:

…the kids will be able to create their own digital story… and the dads will be the ones probably to input the information as the kids come up with the ideas. But … by the end of year, I think there are some kindergarteners who could probably do it on their own. (L., Interview 3, November 5, 2013)

As student matured they were able to work independently in longer activities. Megan’s students spent close to 40 minutes several class sessions a week drawing in their sketchbooks.

How participants constructed their problem statement was one of the first steps in the problem-solving process. Jonassen (1997) suggested that problem-solvers attempt to represent a problem mentally by decomposing what they are given and this process of representation intentionally linked the problem to existing knowledge. Expert technology integrating problem-solvers relied heavily on experience and knowledge in constructing a problem statement. The following discussion of the knowledge and experience involved
in constructing a problem statement was organized by conditions, content, and role of technology.

The results indicated three types of conditions under which the development of a problem statement occurred: individual teacher, collaborative teacher, and collaborative support. Three participants planned individually and one teacher participated in collaborative planning with other teachers on a regular basis. The two participants in support roles either planned with or for other teachers.

The condition individual teacher referred to a classroom teacher who planned in isolation for one content area. Participants who planned individually to create their problem statement tended to be the only, or one of a few, teachers in their content area in their respective schools. The three of the six participants in this study planned independently of other teachers. The results of this study affirmed one of Zhao et al.’s (2002) conditions for successful technology integration that the less dependent teachers were on the cooperation, participation, or support of other people the more successful the innovations.

The collaborative teacher condition under which one teacher planned referred to a classroom teacher who planned in collaboration with other teachers of same content and did not include grade-level collaborative planning. Henry was the only teacher of the six participants who planned collaborative on a regular basis to create his problem statement. As one of five Physics teachers at his school, Henry’s common planning meetings had a formal agenda on Mondays during which teachers discussed assessment data, instructional strategies for addressing student misconceptions, and upcoming activities, while the common planning sessions for the rest of the week were much more informal.
conversations. Regarding the more routine activities, the Physics teachers divided up planning tasks; “one person will do the ‘Bell Ringers’, one person will be responsible for doing test review, another will be responsible for putting the test together and we disseminate that information amongst ourselves; we share the information (H. Interview 2, October 4, 2013).

Planning either for or with a teacher in any content area was a condition referred to as collaborative support. Two participants had a specialized role for instructional technology in their respective schools: one as a Media Specialist and the other as an Instructional Technology Specialist. Brandon and Laurie did not have a traditional classroom of students, but instead worked collaboratively with teachers to develop problem statements. Brandon tended to plan for teachers. Laurie was inclined to plan with teachers at her school.

The courses the participants taught reflected two general categories: process-oriented or technology-oriented support. Process-oriented referred to content and strategies associated with teaching the content that emphasized starting with foundational concepts and building upon those concepts to create more complex ones. Ertmer et al. (2001) referred to teachers with process-oriented visions, as those who used strategies to help students gain higher-level thinking skills such as problem-solving, critical thinking, or lifelong learning skills.

All four of the participants in a teacher role taught process-oriented subject matter and had a structured method for sequencing course topics. At the secondary level, Henry and Ronan taught science and mathematics respectively and Felicity and Megan taught art. These four teachers viewed their content as process-oriented and introduced
foundational concepts before teaching more complex concepts. Constructing the
*problem statement* for *process-oriented* courses complemented the procedural nature of
learning a technology tool; starting with simple steps and building to more complex ones.

*Technology-oriented support* referred to teaching a technology tool or strategies
associated with teaching a variety of content using technology. An emphasis on
instructional technology support was not to suggest that teaching the content was
secondary. The term referred to the possibility that a teacher may request support on how
to use a particular tool in an instructional context, necessitating the need for an educator
in instructional technology support role to focus on a technology tool. This term did not
mean that Brandon and Laurie were *technocentric* in their planning, but instead they
contributed instructional technology expertise to a collaborative planning process through
their knowledge of the affordances of technology tools. *Technology-oriented support*
was embedded in Laurie’s content. As a Media Specialist she taught information literacy.
Her curriculum required that she focus on various digital and non-digital reference
sources and how to use the library.

Participants described the role of technology in their teaching in different ways.
Commonalities in their descriptions were that technology should be meaningful, serve an
instructional purpose, and opened up new possibilities for learning. These descriptions
were consistent with Ottenbreit-Leftwich’s (2007) research on expert technology-
integrating teachers. She also found that teachers used “technology with a purpose, not
for technology’s sake, but for a purpose they believed was critical to the success of their
students” (p. 73).
Brandon said “If it’s not necessary or if it’s superfluous,” do not use technology (B., Interview 1, September 12, 2013). Laurie wanted to “make sure that the activity [involving technology] is a fit with the content, that it really serves a purpose” (L., Interview 3, November 5, 2013). According to Megan, technology was “a way to open up the world of art history” in her Studio classes (M., Interview 3, November 5, 2013). Henry described technology as inseparable from the content: “They mesh as one… it’s almost like a marriage. It’s like, like peanut butter and jelly” (H., Interview 3, November 4, 2013). Technology made Ronan’s teaching and learning “so much more efficient” (R., Interview 3, November 4, 2013). Felicity saw it “fitting in all the time for instruction, …[but] not fitting in all the time for art production, meaning that she used technology all the time to facilitate her instruction but that her students did not always use technology to create art.

Expert technology integrating teachers built a problem statement by reassembling the deconstructed parts that were presented before them into appropriate representations for their students. The results indicated that there were three types of conditions under which the development of a problem statement occurred: individual teacher, collaborative statement, and collaborative support. The participants’ course content reflected two general categories: process-oriented or technology-oriented support. The participants’ believed that technology played a meaningful and purposeful role in their instruction.

**Design space.** Planning literature indicated that most teachers focused on student activities (Koeller & Thompson, 1980; Peterson & Clark, 1978; Shavelson & Stern, 1981; Zahorik, 1975) and rarely articulated their planning processes and were guided by
intentions, intuition, tacit knowledge and mental representations (John, 2006). Because these processes tended to be non-verbal, a common method to elicit teachers’ decision-making while planning was to prompt teachers to express their thoughts. From the literature, capturing decision-making was an important part of understanding the problem solving process in general. One method for capturing decision-making was through think-aloud protocols. Participants in this study were prompted to describe and reflect upon their planning practices to construct a planning problem space. The findings indicated that participants created a flexible structure of activities and routines around which new solutions paths were created.

Although there were several solution paths to take in the design space phase of planning technology-integrated instruction, Yinger (1980) suggested that structure was the dominant feature. Yinger (1979) referred to activities as the basic structural units of planning and action in the classroom. Participants in this study structured their class sessions around instructional activities. Overall participants tended to have three main activities in each class session whether the class was 30 minutes or 90 minutes long (see Figure 17). For simplicity the routines were represented as continuous throughout the lesson but the actual lessons were designed for specific purposes (e.g., management, lesson closure) and age levels. On the elementary school level routines existed as separate activities. In Felicity’s class, she alternated between management routines and activities, but the routines were not necessarily part of an activity such as being Monificent. At the secondary level the students were generally more mature and were able to handle longer activities. The participants exhibited a domain expertise for structuring activities and routines geared toward a particular age group and specific
Elementary Patterns
Felicity: $R \rightarrow A \rightarrow R \rightarrow A \rightarrow R$
Laurie: $R \rightarrow A \rightarrow R \rightarrow A \rightarrow R$

Secondary Patterns
Brandon: $R \xrightarrow{A} A \xrightarrow{A} A$
Henry: $R \xrightarrow{A} A \xrightarrow{A} A \xrightarrow{A} A$
Megan: $R \xrightarrow{A} A$
Ronan: $R \xrightarrow{A} A \xrightarrow{A} A$

Figure 17. Patterns for activities and routines. The figure shows the general activity structures by participant. $A =$ Activity and $R =$ Routine.

content area and would not necessarily be comparable to other subjects or student ages. Their knowledge regarding not only their curriculum but also student abilities was contextually bound by the nature of their students.

Solution paths. All participants indicated that they started planning for technology integration with learning goal in mind and then searched for activities to accomplish this goal. Although, each participant had an individual preference for problem solving with technology in teaching and learning, the following is a description of a solution path to represent the general tendencies of the participants. The search for activities typically followed two paths: search from prior knowledge and experiences or create a new activity. The focus of both paths was to improve upon a previous implementation of the content. This improvement occurred from year-to-year, lesson-to-lesson, or within-a-lesson. The creation of a new activity may also include pieces of previously implemented activities but this creation also included seeking new resources (technology or non-technology) to enhance instruction. The process of planning for
technology integration tended to follow the path of discovering a new resource from a variety of sources (e.g. Internet, peers, professional development), exploring the affordances, *breaking it* by troubleshooting for what could go wrong during implementation, and rebuilding it into an instructional activity.

**Goal state.** The participants had a variety of strategies for arriving at a goal state. Ronan, who planned individually, rarely wrote his daily plans and carried them in his working memory. Megan and Felicity also planned individually but used their *PowerPoint* and *Keynote* presentations respectively to structure their plans. Laurie created lists to use as prompts when planning. Brandon only wrote plans if he created them for someone else to use, but Henry preferred very detailed written plans. Table 15 provides a summary of preferences for the participants.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Planning situation</th>
<th>Written plan required</th>
<th>Actual plan</th>
<th>Guide during lesson</th>
</tr>
</thead>
</table>
| Brandon     | Collaborative       | No                    | Written     | Teacher material: Lesson plan  
Student materials: handouts, assessments |
| Felicity    | Individual          | No                    | Presentation | Teacher material: Presentation |
| Henry       | Collaborative       | No                    | Written     | Teacher material: Lesson plan |
| Laurie      | Collaborative       | No                    | Written     | Teacher material: List |
| Megan       | Individual          | Yes                   | Presentation | Teacher material: Presentation |
| Ronan       | Individual          | Yes                   | Mental      | Student materials: handouts, assessments |
Summary

In the planning task environment, participants encountered several factors related to the school environment, the learning environment, curriculum, and resources as they planned for instruction. The planning problem spaces of the individual participants revealed how they interpreted their curriculum, created a design space, and arrived at a goal state. Participants demonstrated problem-solving skills, flexibility, perseverance, and a sense of fearlessness as they continuously sought to improve their instruction through the use technology.
CHAPTER 5

DISCUSSION

Educational institutions are accumulating technology resources that contribute to innovative practice and learning creating pressure on teachers to integrate these resources into their instruction (Hughes, 2005; Tubin & Edri, 2004). There is, however, a gap in the amount of technology available in schools and teachers’ use of that technology for instructional purposes (Kopcha, 2012). One reason for this gap is a lack of technology-supported pedagogical knowledge (Hew & Brush, 2007). The power to develop innovative technology-supported pedagogy resides in the teacher’s interpretation of a technology’s value for teaching and learning in the classroom, mediated by the teacher’s experience and knowledge (Hughes, 2005). The expert technology-integrating teachers in this study possessed technology-supported pedagogy that they could draw upon during planning for technology integration. The term planning referred to the point at which these teachers first considered resources, specifically technology resources for instruction. Jackson (1965) referred to this point as the preactive phase of teaching: the period before teaching during which teachers planned lessons and evaluated and selected methods and materials to teach (Tsui, 2003).

The purpose of this study was to explore the planning strategies that teachers, identified as experts, used in designing technology-integrated instruction to better understand these complexities. This study provided a window into thoughts, decision-making, and judgments of technology-integrating experts as they planned for instruction. From the perspective that teaching with technology is an ill-structured problem and teachers are problem solvers, planning for technology integration by these expert teachers
took place in a teacher planning problem space. A teacher planning problem space is comprised of two components: the planning task environment and planning problem space. In the planning task environment, teachers interpret a given set of conditions outside of their control and construct their own planning problem space. The planning problem space is a metaphorical space within which teachers employ problem-solving strategies to design and implement instruction.

Using the teacher planning problem space model, the main research objective that focused the study was: How do expert teachers plan for technology-integrated instruction? The sub-questions were:

1. How do expert teachers negotiate the planning task environment?
2. How do expert teachers negotiate the planning problem space?

A single case study was chosen as the most appropriate methodology to best represent expert planning in a teacher planning problem space because the methodology was well-suited to gain an in-depth understanding of in context processes and it emphasized discovery rather than confirmation (Merriam, 1998). The case was constructed using a variety of data including a survey, interviews, and lesson artifacts. Qualitative Content Analysis (QCA) methods were used for analyzing how expert technology-integrating teacher negotiated the teacher planning problem space because QCA, like case study, also focused on process, was specific enough to provide a structure, emphasized the importance of context (Hsieh & Shannon, 2005), and allowed for flexibility (Schreier, 2012). The individual participants’ teacher planning problem spaces were presented in Chapter 4. Chapter 5 is organized by themes that emerged from the data that represent the case: The teacher planning problem space of expert
technology-integrating teachers. After presenting the case, the study’s implications, limitations, and recommendations were addressed.

The Case

A single case represents the teacher planning problem space of expert technology-integrating teachers. The case is built from the five themes that emerged during data analysis to answer the main research objective: How do expert teachers plan for technology-integrated instruction? Of the five themes, two served as strategies for negotiating the planning task environment. The remaining three characterized the how experts negotiated the planning problem space. The following is a description of the expert planning problem space of technology-integrating teachers.

Negotiating the Planning Task Environment

According to Zahorik (2007), time was one of the most challenging constraints a teaching faced in trying to achieve curricular goal and meet students’ needs, while managing administrative responsibilities associated with the job. In negotiating the planning task environment, this study revealed that these experts did not perceive a lack of access to resources, administrative support, or time for planning. Instead the experts changed their behavior and adapted to their individual situations to make the most of their environment. Two major themes emerged as planning strategies for expert technology-integrating teachers: follow polices and procedures and maximize resources.

Follow policies and procedures. The findings suggested that experts follow policies and procedures set forth by their administration because experts did not perceive their administrative requirements as unrealistic; hence policies and procedures did not seem to interfere with planning for technology integrated instruction. These experts
followed polices and procedures in order to get to the most important part of their day: instruction.

Several factors may have contributed to the experts’ perceptions regarding their administration’s policies and procedures. According to Carter et al. (1987), experts were comparatively more judgmental than non-experts regarding policies and practices that have the potential to influence their own instruction. The experts in this study referred to their administration as being supportive and as a result may not have felt like they were being asked to perform unreasonable tasks that took away from planning for and implementation of instruction. For example, the lesson plans these expert teachers were required to submit had minimal requirements such as general statements about objectives, activities, and assessments. Because these experts did not have to provide elaborate, detailed lessons, they felt their administration trusted them to teach their students without having to justify every instructional decision. This notion of trust, whether it actual or perceived, contributed to the experts positive feelings toward their administrators and provided what Carter et al. (1987) referred to as experts’ need for ownership of information and the decision-making process.

Another factor that may have influenced experts’ perceptions was that the tasks associated with their administrative responsibilities were not time consuming. The experts in this study were all effective time managers. So the idea that their school’s policies and procedures were not time consuming may be attributed to these expert teachers’ time management abilities rather than a given set of reasonable requirements.

A third factor, identified as a condition for successful technology integration, Zhao et al. (2002) referred to institutional support as a part of healthy human
infrastructure that was flexible and responsive to teachers’ needs. Experts in this study indicated that they taught in schools that had characteristics of a healthy human infrastructure. The degree to which the administration established this infrastructure or experts constructed the perception of a supportive administration and responded positively may be an interesting line of inquiry for future studies.

Maximize resources. Another finding suggested that expert technology-integrating teachers maximize all resources available. These resources included non-instructional time, instructional materials, the classroom, and human resources. According to McCutcheon (1980), time allocated for planning was an important factor that influenced teachers’ planning decisions. Experts in this study referred to time as either instructional or non-instructional. Instructional time was spent with students and focused on teaching and learning and was the main focus of all the experts. Non-instructional time was everything else including time allocated for planning, administrative responsibilities, and time outside of the regular school hours.

According to the literature, a lack of planning time is cited as a barrier for technology integration (Ertmer, 1999; Groff & Mouza, 2008; Hew & Brush, 2007). Department meetings, parent conferences, and other administrative responsibilities interfere with experts’ ability to plan during scheduled time. In this study, however, expert teachers did not refer to having a lack of scheduled planning time. Instead, they created planning opportunities outside of their scheduled planning time to learn about technology tools for instruction and create technology-integrated instruction. The most common planning opportunity experts created was to modify their workday by reporting early to school or staying late, using the time before or after classes to conduct the bulk of
their planning. Experts who reported early to school or stayed late indicated that they were able to accomplish much more during these hours because there were fewer interruptions: maximizing unscheduled planning time.

Instructional materials included technology and non-technology resources used for teaching and learning. To maximize instructional materials, experts in this study planned by making decisions about when and when not to use technology in their instruction, which contributed to the creation of more meaningful and purposeful technology-integrated activities. These experts did not use technology as way to fill time at the end of a lesson or as an incentive for completing work before other students. Recognizing that technology may or may not facilitate learning in all situations, experts’ main focus was that activities served as a way to learn the content. For example, science experiments tended to be hands-on and technology was not necessary. In art classes, practicing on an iPad as a first step allowed students to easily erase mistakes as they learned new techniques. The ability to determine when and when not to use technology was most likely due to experience. The experts in this study were constantly trying new ways to teach giving them many of experiences from which to draw.

Experts also maximize the space in their classroom by designating spaces and places for activities. Some experts had classrooms designed for their courses including furniture such as lab tables or pottery wheels. Other experts designated spaces within their classrooms to serve as areas for specific activities: desks for working on hands-on activities and the rug for story time. In addition to maximizing their instructional space, these expert also used human resources to help manage the classroom as well as provide
subject matter expertise. Parent volunteers assisted with classroom cleanup and posting student work. Subject matter experts helped to bring the real world into the classroom.

**Summary.** Experts employed two main strategies to negotiate the planning task environment that demonstrated a willingness to adapt to the existing environment rather than fighting to change it. The first strategy was to follow what experts in this study perceived to be reasonable polices and procedures set forth by their administration. Factors that may have contributed to perceptions of reasonableness were that administrative requirements were not time consuming and their administrations trusted them to make sound instructional decisions. The second and most important strategy was to maximize resources. To compensate for a not being able to plan during scheduled planning time, experts create planning opportunities outside regular school hours. Experts also made decisions about how best to use of their classroom space, technology, non-technology, and human resources.

**Negotiating the Planning Problem Space**

A planning problem space represents the mental “space” where teachers do most of their planning. Three key strategies emerged to describe how experts in this study negotiate this space as they designed technology-integrated instruction. The first strategy is to create a lesson structure that serves way to segment common parts of a lesson (e.g. opening, work period, and closing). Within this structure, the second strategy is to demonstrate flexibility and fluidity in planning lesson activities. The third strategy experts tended to employ involved breaking down resources and rebuilding them for teaching and learning. The following is a description of these strategies and how experts use them to negotiate the planning problem space.
Create a lesson structure and establish routines. As experts plan, they tend to create and adhere to overall lesson structure that is aligned to their preferred style of teaching and establish routines. The overall structure of a lesson resembles a series of train cars that correspond to each lesson part. The train cars are linked together by management routines. Within each train car, there is a collection of learning activities and associated routines (see Figure 18). A lesson structure is created according to amount of time the expert spends with each class of students. This time is then divided up into lesson parts. For example, in a 50-minute lesson with a three-part lesson structure, the opening may take 10 minutes, the work period take 25 minutes, and the closing take 15 minutes. This finding is consistent with the results of Leinhardt’s (1989) study involving expert math teachers who displayed an efficient lesson structure characterized by a fluid movement from one activity to another through cohesive, well-rehearsed action systems – or routines.

The most common lesson structure used by experts in this study was a three-part lesson with an opening, work period, and closing. Some experts varied from the three-part lesson; indicating a preferred structure with two-parts (opening and work period) or four-parts (opening, discussion, work period, closing). The variations suggest that these experts develop an individual structure to reflect their preferred teaching style. Creating a
lesson structure is similar to what Yinger (1979) referred to as an *executive planning routine* during which experts cultivate a preferential approach to the planning process.

Another planning strategy demonstrated by experts is to establish routines. Arguably all routines are *management routines*, but experts in this study created *instructional activity routines* and *management routines* associated with transitioning from one lesson part to another. *Management routines* were those routines those associated with any specific activity but involved procedures such as transitions between activities or leaving the room (Yinger, 1979). These routines were general in their purpose, such as behavior for starting class, but were specific according to the age of the student. For example, elementary students need much more structured routines for transitioning from one part of a lesson to another. Experts at the elementary level created songs help students know when and how to line up at the door and change classes. High school students have the maturity level to enter the classroom and take their seats by following written or verbal directions.

Yinger (1979) made a distinction between *instructional routines* and *activity routines*. That distinction is not made in this study. Instead routines associated with an activity are considered instructional; hence the term *instructional activity routines*. *Instructional activity routines* are more flexible and adaptable than management routines but follow patterns dictated by an activity rather than a class session. If an instructional activity involves using an iPad, *instructional activity routines* may include the process for turning in an assignment from the iPad.

The purpose of creating a lesson structure and establishing routines is to manage and maximize instructional time. These strategies are an important part of planning
lessons because they create automaticity, which frees experts to focus on more difficult tasks such as instruction. Routines contribute to automaticity, increasing the predictability and decreasing complexity.

**Demonstrate flexibility.** Experts teachers in this study demonstrated flexibility throughout the lesson planning process. A major focus of experts’ planning process is on creating new, refining existing, or redesigning activities for learning. This emphasis on activities is consistent with existing literature (e.g. Koeller & Thompson, 1980; Peterson & Clark, 1978; Shavelson & Stern, 1981; Zahorik, 1975). Experts in this study may have focused on activities because they provided an easy way to change out small pieces of instruction without having to redesign an entire lesson.

One strategy for building flexibility into planning is to create several options to help students learn. These options may come from a vast repertoire of previously implemented lesson activities or from newly designed ones. By creating several options, experts can seamlessly adjust to teaching and learning to accommodate and respond to a multitude of things that can happen in the classroom such as student difficulties with learning the content or interruptions due to fire drills and assemblies. Another strategy experts incorporate into their planning is to try new ways of teaching the content. While the overall lesson structure remained fairly static, the experts in this study seemed to possess an innate curiosity for finding new and better ways to teach by changing the lesson activities on a regular basis. Reasons cited for changing activities were to keep the content current, improve upon previous implementations, and create entertain lessons for both the expert and the students.
Maximize learning. Experts maximize personal learning as they plan for technology-integrated instruction. According to experts in this study, they take every opportunity to learn about new resources, and from successful and unsuccessful implementations. An unsuccessful implementation is not the same as a failure. Experts in this study did not refer to what they did in the classroom in terms of successes and failures. Every implementation of a plan, successful or not, was considered learning experience. If an activity did not go as well as planned, experts perceived the experience as an occasion from which to improve. The experience was used to inform the next set of planning decisions.

To learn a resource, specifically a technology resource, experts in this study explored how the technology tool works and its instructional uses by evaluating the affordances and limitations as well as usability. To maximize learning when planning technology-integrated instruction, experts employed a break it and rebuild it strategy. This strategy allowed experts to learn the resource as they planned for the instructional strategies needed to teach with the resource. Break it refers to the process in which experts in this study break down aspects of a technology tool in to step-by-step processes and assess what can go wrong during use. These experts assessed features of the tool that were difficult for them to learn and make judgments regarding the feasibility for student use. To rebuild it, experts determined instructional strategies needed to teach students the content using the tool, the time needed to teach aspects of the tool, and plan for implementation. When rebuilding the tool for specific instructional purposes, these experts tended to create plans with step-by-step processes. The processes did not separate the content from the technology tool but combined a content-focused step with only the
necessary associated technology-focused step. Rebuilding in a step-by-step way is similar to the strategy for creating a lesson structure. The step-by-step procedures for students to follow, afforded these experts the freedom to move about the classroom during implementation to troubleshoot individual student issues. It also provided a way for these expert teachers to judge the successfulness or unsuccessfulness of particular steps in a lesson and adjust on the fly if necessary. Additionally, because these experts used technology regularly in their instruction, they have a good sense of their students’ abilities and time constraints when using technology. This awareness, allowed the experts to make better planning decisions.

**Summary.** Experts in this study employ three main strategies to negotiate the *planning problem space*. The first strategy is to create a lesson structure and establish routines, which contribute automaticity and create the freedom for these experts to focus on learning activities. The second strategy is to demonstrate flexibility throughout the lesson planning process but most notably in planning lesson activities. Because these experts are concerned with improving instruction and creating engaging and current content, they tended to change their learning activities often. Of the three strategies, the third, or maximizing learning through a *break and rebuild* process is the most important. This strategy combines the structured and flexible aspects of expert planning for technology-integrated instruction and allowed them to respond more quickly to student needs.
Implications

Spector (2010) uses the word technification to describe the degree to which a technocrat dominated a field, whereby they control and have access to it because of their special knowledge and skill. The original context of the technocrat and technification is that of an issue that negatively impacts the field of education and broaden the gap in areas such as the digital divide. Pulled out of its original context at a macro level and applied at the micro level of a classroom in which the teacher as the classroom technocrat is an expert who makes decision about technology integration based on special knowledge and skill. At the micro level the classroom technocrat can be seen as skillful at operating within the constraints of policies and procedures that are out of their control and putting their expertise to work to create a unique technology-rich learning environment for students. This special group of teachers live on what Forkosh-Baruch et al. (2005) deemed as islands of innovation. How do we turn these islands of innovation into places in which all teachers integrate technology? The key is in teacher planning. The following section details the theoretical and practical implications of this study.

Theoretical implications

The results of this study have theoretical implications for learning to plan for technology integration based on the teacher planning problem space model, rethinking the negative connotations associated with technocentrism, and rethinking expertise as the highest or final stage of technology integration. The following is a description of the theoretical implications of this study.
The revised model. The teacher planning problem space model is unique to this study and holds potential for future research for teacher expertise in planning and technology integration. The initial model was created based on existing planning literature which took place prior to the pervasiveness of technology in the classroom (Richardson, 2009). After conducting the study, the model was revised to reflect how experts plan for technology integration rather than how all teachers could plan (see Figure 19). The revised model reflects the case that was constructed to represent the strategies experts in this study used in planning.

The revised model has implications for teacher preparation programs as well as for inservice teachers who struggle with technology integration. This planning problem space part of model has the flexibility built in to accommodate pre-services teachers as well as inservice teachers. For new teachers, John (2006) suggested that they need to first understand what a lesson plan it and then that they may benefit from some structure as they learn. Using the revised model, a teacher educator can prescribe a lesson structure in the early phases of learning. As a student teacher develops a teaching style and establishes routines the lesson structure can be adapted to fit individual teacher needs. Because inservice teachers most likely have established teaching styles and corresponding lesson structures, they would start with their preferred lesson structure and routines.

The solution path has limitless possibilities for solving instructional problems. At this stage of planning, mentors and collaboration become an important part of the process, providing what Ermter (1999) described as opportunities to observe models of integrated
technology use as well as to reflect, discuss, and try out new ideas about teaching and learning with technology.

**Rethinking technocentrism in technology integration expertise.** Seymour Papert (1987) coined the term *technocentrism* which is the misconception that technology will solve instructional problems. The experts in this study, however, did use technology to solve instructional problems. Possibly because they had at least four years experience to develop their content knowledge and pedagogical skills, these experts turned to technology to improve their instruction. Thus for experts the entry point for planning was not necessarily content focused because content was a foregone conclusion. Why else would they be in the classroom, except to teach their content? And because the content was relatively static, e.g. theorems and postulates in Geometry did not change from year to year, the best way for experts to enhance instruction was *how* they taught their content: a combination of technology and pedagogy. These experts tackled
technology like they tackled their content: they grabbed it, broke it, and put it back together in ways that made sense; hence they found the best representation while simultaneously considering student learning. For expert technology integrators, focusing on the technology tool and its affordances was not at the expense of content or pedagogy.

The literature (Harris & Hofer, 2011; Harris et al., 2009) portrays technocentrism as an ineffective strategy both for technology integration and for new teachers who have not yet matured in other areas such as content and pedagogy. For experts, however, focusing on a technology tool provided a valuable process for assimilating or discarding that tool based on its usefulness in learning. Perhaps a new term needs to be coined to distinguish experts’ ability to identify affordances from non-experts’ technocentrism. But by that same token, maybe non-experts could learn from exploring the possibilities of a tool first and then look for content applications.

**Rethinking expertise in technology integration.** Experts in this study possessed characteristics of expertise identified in the literature (e.g. Berliner, 2001a; Leinhardt & Greeno, 1986; Peterson & Comeaux, 1987; Shulman, 1987; Sternberg & Horvath, 1995). These characteristics were evident in how these experts planned for technology integration.

The research object of this study was to identify how expert teachers planned for technology integration, but the participants actually demonstrated how they attempted to improve instruction through technology integration. Where does the desire to continuously improve instruction fit into expertise? Does it warrant new terminology? What represents the constant pursuit of excellence? *Aretè.* *Aretè* is a term frequently translated as *virtue* but a better interpreted as *excellence* (Verbeek, 2009). Central to
ancient Greek culture, the development of *aretē* was thought of as human excellence, changing yet constant, enriched and refined over time into the heroism of mind and spirit (Park, 1983). The results of this study suggested that these experts did not consider themselves to be at the highest level of accomplishment in teaching. Instead they sought to improve with every planned implementation of a lesson.

**Practical implications**

Practical implications of this study include school polices and requirements for turning in written lessons plans and useful advice for integrating technology from experts in this study.

**Written plans.** Their written lesson plans, according to experts in this study, did not indicate what they were actually going to do in their classroom, confirming what John (2006) described as a *perfunctory act* that presents a powerful generic idea, but tells little about the substance of a particular lesson. If the purpose of lesson plans is to provide an idea of the instruction that occurs in the classroom, then the traditional lesson plan format does not provide this. What purpose is served by turning in lesson plans that do not reflect classroom instruction? These experts indicated that they did not receive feedback on their lesson plans. What do administrators do with the lesson plans they collect? Having an alternative to the written lesson plan requirement would be a more efficient use of both teachers’ and administrators’ time.

**Advice from experts.** The six experts in this study had practical advice for new teachers learning how to integrate technology into their instruction. The first piece of advice was to *be adventurous*. The overwhelming sentiment to be curious and was to
seek out new technology tools to use in the classroom. According to one expert, it was important to “play with technology and not wait for someone to come along and say, ‘Use this!’” (M., Interview 3, November 5, 2013) Also important was to think about “how to teach the lesson first and then bring the technology in.” (B., Interview 3, November 6, 2013)

A second piece of advice was to keep learning by asking questions and seeking out other educators. Experts in this study felt it was important to get connected to teachers who could provide new ideas for teaching content through social media or attending conferences.

The last two pieces of practical advice were to be prepared and be patient. Integrating technology into teaching and learning “takes work ahead of time” (F., Interview 3, November 6, 2013). Allow time for learning the tool as well as troubleshooting what can go wrong. To be prepared, one expert conducted what he called beta testing on small groups of students to see if his plans would work with the rest of his students (R., Interview 1, September 4, 2013). Then be patient with the learning process. According to one expert:

It does take a learning curve to master these applications and then you know [them], also when you have shortcomings with the technology, when it dies down, when it goes out; you can’t be flustered by that. You can’t let it deter you from the final goal. (H., Interview 3, November 4, 2013)

All the experts in this study acknowledged the difficulties of integrating technology but indicated that the rewards definitely outweighed the challenges.
Limitations

One major limitation related to this study was the definition and identification of experts and innovative practices. The identification of an expert also continues to be troublesome for researchers, practitioners, and policymakers (Berliner, 1986; Borko et al., 1992; Ertmer et al., 2001). Innovation was also not a widely agreed upon concept, and innovation with technology in an educational setting is even more complex (Forkosh-Baruch et al., 2005). Other researchers may therefore use a different definition for expert, technology integration and innovation.

Another limitation was related to the data collected. Although attempts were made to conduct rigorous and transparent methods for analyzing the data, the data was limited to information that was self-reported by the participants. One way to strengthen the data would be to conduct observations of study participants to corroborate their statements with their actions.

Recommendations

Focus on the affordances. Because the experts in this study demonstrated that they could focus on the technology tool and its affordances without sacrificing content or pedagogy, a recommendation for future research is to explore how learning the affordances contributes to successful technology integration for a teacher population with a range of experience from novice through expert.

Explore alternative lesson plan requirements. Because written lesson plan requirement does not seem to serve an intended purpose, a recommendation for future research is to explore the use of alternative lesson plan formats.
**Explore the break it and rebuild it strategy.** One of the most important findings from this study was identifying the processes that experts undertook to learn new technology tools and prepare for teaching and learning. A recommendation for future research is to study the different ways in which teachers employ this strategy in planning for instruction with technology integration.

**Test the model in different contexts.** The teacher planning problem space model was designed to study experts and technology integration. The experts in this study did not represent a diverse population in terms of race, the socio-economic status of students, and availability of resources. Implementing the model in a variety of different contexts in which experts contend with far more constraint may prove interesting when compared to the results found in this study.

**Explore alternative research methods.** Because this study was limited to self-reported data, one recommendation is to conduct a similar study in a variety of contexts using different research methods including observations of actual teaching situations.
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America’s teachers innovate every day.

2012 Teacher Innovator Awards: Official Rules

No Purchase Necessary

1. Contest Description:

The “2012 Teacher Innovator Awards” (the “Contest”) is sponsored by the Public Broadcasting Service, with its principal place of business located at 2100 Crystal Drive, Arlington, VA 22202 (“Sponsor” or “PBS”) and The Henry Ford, a Michigan non-profit corporation with offices located at 20900 Oakwood Blvd., Dearborn, Michigan 48124. (“Sponsor” or “THF”) The contest will begin on or before 11:59:59 PM Eastern Time (“ET”) on September 26, 2012 and will close for entries at 2:59:59 AM ET on December 13, 2012 (11:59:59 PM PT on December 12, 2012) (the “Promotion Period”). Contest is void where prohibited or restricted by law. By entering the 2012 Teacher Innovator Awards, each entrant accepts and agrees to be bound by these official Contest rules (the “Official Rules”).

2. Eligibility:

To be eligible, an entrant must be at least eighteen (18) years old at time of entry and a legal resident of the fifty (50) United States or the District of Columbia. Contest entry is limited to one (1) video per person. You may only enter the contest one time. Multiple entries from the same person will be disqualified. Contest is also limited to one (1) person per entry. Entries from teams of people will be disqualified. Top 10/first place winners from the 2010 and 2011 PBS Teachers Innovation Awards are not eligible to enter this Contest, but may serve as judges. Employees and immediate family members of THF, PBS or PBS’ public television member stations are not eligible to participate in this Contest. No purchase is necessary. Sponsor reserves the right to disqualify ineligible entries; such entries will not be returned.

Entrant must be one of the following:

- PreK-12 Classroom Educator (Public, Private, or Charter School)
- PreK-12 Library Media Specialist or Technology Specialist/Coordinator
- PreK-12 Homeschool Educator
- PreK-12 Head Start or Licensed Daycare Teacher
3. **How To Enter:**

Each contest entrant (each an “Entrant”) must complete the following to enter the Contest:

a. Register to be a member of [PBS LearningMedia](https://pbslearningmedia.org) by entering your general information – first name, last name, zip code, username, and type of educator (ece, tech, k-12, etc.)

b. Accept the PBS Terms of Use.

c. Enter information about your entry – as requested on the entry form.

d. Submit a video clip or PDF file with text and images that depicts or describes the ways in which you are an innovative educator within one of the Grade and Subject Groupings described below. The entry must consist of either a demonstration of innovation with students (inside or outside of a classroom) or an innovative project that was the result of an instructional activity you conducted. Video clips are limited to 3 minutes in length. PDFs are limited to 3 pages in length. Any fees incurred by the entrant in creating the video clip or PDF will be the sole responsibility of the entrant. Please see section 7 below titled “Additional Submission Rules” for complete Entry requirements and prohibited content.

e. Completing the foregoing will earn Entrant an entry (“Entry”) into the Contest.

**Grade and Subject groupings:** Entries must consist of material that was/is used while teaching one of the below categories. One (1) First Place Winner, one Second Place Winner, and one Third Place Winner, as defined in section 5 below, will each be selected from within all of the following categories for a total of thirty (30) Winners:

- PreK-5th Grade Arts
- 6th-12th Grade Arts
- PreK-5th Grade Math
- 6th-12th Grade Math
- PreK-5th Grade Reading & Language Arts
- 6th-12th Grade Reading & Language Arts
- PreK-5th Grade Science
- 6th-12th Grade Science
- PreK-5th Grade Social Studies
- 6th-12th Grade Social Studies

**Important Tips:**

- Limit one Entry per Entrant throughout the Promotion Period.
- Once Entry has been submitted, Entrant will receive an e-mail confirming submission. Sponsors shall not be responsible for garbled, corrupted, or otherwise lost or deleted Entries, whether as a result of human, technical or other error.
- Make sure to check the e-mail account used in connection with the Entry, as any winning notification and subsequent communication will be sent via e-mails. Entrants who do not win will not receive notification.
- Read the Official Rules in full before submitting an Entry.
- Entries will not be returned. Upon submission, Entrants grant Sponsors a non-exclusive, irrevocable license to use and modify the Entry, in whole or in part, for commercial purposes, without any payment or other consideration, for use on any media now known or hereafter discovered, in perpetuity, to the extent legally permissible.

4. **Winner Selection:**
Winners will be selected by a panel of judges using judging criteria, as defined below.

Entries will be judged by a panel of educators selected from among the 2010 and 2011 PBS Teachers Innovation Award winners, PBS TeacherLine facilitators, educational advisors to The Henry Ford, and/or representatives from education related professional content organizations. Judges will not be permitted to enter the contest.

Each entry will be reviewed by two judges, who will score each Entry individually. The entries will be judged on the following criteria, each of which will be worth a total of 20 points (10 points per judge), for a maximum score of one hundred (100) (or one hundred one (101) in the event a “bonus point” is obtained, as described below): (a) innovation/originality/creativity; (b) application or reinforcement of 21st century learning skills; (c) effective integration of digital media; (d) student engagement, and (e) student learning. Judges will be assigned Entries based on subject area and grade level in order to ensure judging expertise in selected areas. Judges will be required to abstain from judging if a conflict of interest is or becomes present. The final entry score (the “Score”) will consist of the addition of the two judges’ individual scores, and such Score will be used to determine the winners (“Winners” as more fully defined in Section 5 below). After the Score has been calculated, one bonus point will be given to each entry that clearly demonstrates how a resource from The Henry Ford’s On Innovation website (http://www.oninnovation.com/) or a resource from a PBS station, a PBS website or a PBS on-air program was used or modified to enhance the lesson or project. For purposes of this Contest, a PBS resource shall mean a resource from PBS LearningMedia, PBS Teachers, PBS Television, PBS.org, PBSKIDS.org, PBS TeacherLine, or a local PBS television station resource.

In the event of a tie in the Score (including the bonus point, if applicable), a PBS Education employee or an employee from The Henry Ford will serve as a third judge, using the same judging criteria and process described herein. Tie breaking scores will be used individually to determine order within tied scores, but cannot elevate a submission from Third Place to Second Place, or from Third or Second Place to First Place (as more fully described in Section 5 below).

Entries will be scored with a uniform rubric; the Winners will be determined after the Contest concludes at the end of the Promotion Period, and will be announced approximately during the month of March 2013. The top scoring Entry within each of the 10 subject/grade groupings described below will be considered a first prize winner. The second highest scoring entry within each of the 10 subject/grade groupings will be considered as second prize winners. The third highest scoring entry within each of the 10 subject/grade groupings will be considered as third prize winners. In total, once judging is completed there will be 30 Entries considered Potential Contest Winners. Potential Winners will be considered official Winners once Sponsors have ascertained a potential Winner’s eligibility and full compliance with these Official Rules.

5. Prizes:

The Contest has three prize levels:

**First Prize.** There will be a total of ten (10) First Place Winners, each of whom will receive a first prize (each a “First Prize”). The top score within each of the ten (10) subject/grade groupings will receive the first prize for a total of ten (10) first prize winners: a week long "Innovation Immersion Experience" at The Henry Ford (http://www.thehenryford.org/) in Dearborn, Michigan in August 2013. The trip includes roundtrip airfare, lodging at The Dearborn Inn, select meals, and special events. Some meals and incidental expenses must be covered by the entrant. Approximate retail value of the First Prize is $2,000 USD. Actual retail values may vary, depending on factors such as airfares. Any difference between the actual retail value and approximate retail value of the prize will not be awarded. In addition, the ten First Prize winners will receive a free PBS TeacherLine professional development course (http://www.pbs.org/teacherline).
Total Approximate Retail Value of First Place Prizes: $20,000 USD.

PBS will notify the First Place Winners via e-mail by March 31, 2013. Winners must respond via e-mail and/or as otherwise instructed to do so in the notification, within five (5) days of the date of notification, in order to confirm their acceptance of the First Prize. Winners must respond by sending a response e-mail to the PBS or THF staff member who notified Winner of the award by and completing and returning a signed affidavit of eligibility and a liability release form without modification. Should a First Place Winner be unable to accept a First Prize, he or she may, at the sole discretion of Sponsors, have the option of receiving a Second Prize or a Third Prize instead, provided that he or she must satisfy the requirements for receiving a Second Prize and a Third Prize, respectively. The top scoring Second Place Winner from the same Grade and Subject grouping may then be invited to accept the remaining First Prize if he or she satisfies the requirements for receiving the First Prize, and at the sole discretion of Sponsors.

Second Prize. There will be a total of ten (10) Second Place Winners, each of whom will receive a second prize (each a “Second Prize”). The second highest scoring Entries within each of the 10 subject/grade groupings after the first prize will receive the Second Prize: a gift bag from PBS and The Henry Ford containing various premium items and a Promethean ActiView document camera. Approximate retail value of the Second Prize is $600. Actual retail values may vary. Any difference between the actual retail value and approximate retail value of the prize will not be awarded. Second Place Winners will be contacted to confirm mailing address and the prize will be shipped directly to the Winner at his or her requested address after completion and return to PBS of a signed affidavit of eligibility and a liability release form without modification. Entrants should allow a minimum of four to six weeks for delivery of the gift bag and camera.

Total Approximate Retail Value of Second Place Prizes: $6,000 USD.

Third Prize. There will be a total of ten (10) third place winners, each of whom will receive a third prize (each a “Third Prize”). The third highest scoring Entries within each of the 10 subject/grade groupings after the first and second prizes will receive The Third Prize: a gift bag from PBS and The Henry Ford containing various premium items. Approximate retail value of the Third Prize is $50. Third Place Winners will be contacted to confirm mailing address and the prize will be shipped directly to the Winner at his or her requested address after completion and return to PBS of a signed affidavit of eligibility and a liability release form without modification. Entrants should allow a minimum of four to six weeks for delivery of the gift bag.

Total Approximate Retail Value of the Third Place Prizes: $500 USD.

Tax Consequences. Winners will be solely responsible for any and all local, state, and federal taxes incurred by their participation in the contest. Prizes may not be exchanged for cash or any other consideration. Sponsor will report any individual winnings over $600 (in cash or fair market value of goods or services) in a one (1) year period to the Internal Revenue Service. Winners will receive a Form 1099 from Sponsor if Sponsor reports any such winnings to the Internal Revenue Service.

6. Conditions and Limitations Apply:
   o Sponsor reserves the right to edit Entry content, including, but not limited to, any photographical or video material comprising, in whole or in part, the Entry.
   o Sponsor is not responsible for lost, late, or misdirected entries, including due to network failure.
   o Sponsor reserves the right to use any information submitted by Entrants for any purpose whatsoever.
   o All Winners agree to the use of their names and likenesses in publicity without notice or any additional compensation, except where prohibited by law. By entering this Contest,
the Winners acknowledge that Sponsor has the right to publicize and broadcast their name, voice, and likeness, the fact that they won, and all matters incidental thereto. Sponsor is not obligated to attribute Entry to the Entrant who submitted it.

o By entering this Contest, each Entrant forever discharges and releases Sponsor and its respective directors, officers, employees, agents, and subsidiaries (collectively, the “Released Parties”) from any and all liability, claims, causes of action, suits, and demands of any kind (collectively, “claims”) arising from or in connection with the Contest.

o The Contest and these Official Rules are subject to modification by Sponsor in its sole discretion.

o An Entrant is not a Winner unless and until Entrant’s eligibility has been verified and Entrant has been notified that verification is complete. In the event that a Winner is determined to be ineligible, his or her prize will be forfeited and Sponsor reserves the right to select an alternate winner from among remaining eligible Entries.

o Sponsor reserves the right to terminate the Contest without awarding prizes if no eligible winner or alternate winners claim the prizes within the required time.

o Sponsor reserves the right to add to the First, Second, and Third Place Prize Packages should additional prizes become available.

7. Additional Submission Rules:

By participating in the Contest and submitting materials (the “Materials”) to 2012 Teacher Innovator Awards you agree to and represent the following:

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o You represent that the Materials do not contain material that is (a) unlawful, obscene, offensive, defamatory, libelous, threatening, fraudulent, abusive, pornographic, harassing, or encourages conduct that would be considered a criminal offense, or does or could give rise to civil liability or violate any law, rule, or regulation, or is otherwise objectionable; (b) non-public information about any company that you are not authorized to disclose; and (c) an advertisement, solicitation, chain letter, pyramid scheme, investment opportunity, or other unsolicited commercial communication; (d) otherwise in poor taste or not appropriate for use in a classroom, at the sole discretion of Sponsors. Any Materials containing any of the above will be automatically disqualified at the sole discretion of Sponsors.

o You guarantee that any persons whose name, image, likeness, or personal information is used or depicted in the Materials have validly consented to such use or depiction. Valid consent shall mean the knowing, written acquiescence of such use or depiction as part of the Materials signed by the person whose name, image, likeness, or personal information is used or depicted. In addition to the foregoing, valid consent with respect to the use or
depiction of any minor’s name, image, likeness or other type of personal information, shall also include the knowing, written acquiescence of such use or depiction as part of the Materials signed by the minor’s parent or legal guardian. Such use or depiction must also be done according to the terms, if any, of the school, institution, and/or School Board to which the student belonged at the time such image, likeness, or other information was obtained. Materials that are submitted in violation of any school, institution, or School Board’s terms, will invalidate the Entry in connection with those Materials. At discretion of Sponsors, Entrant may be required to provide proof of compliance with all terms herein, failure to provide proof of valid consent or adherence to any applicable terms, as described above, to the satisfaction of Sponsors, will result in the invalidation of that particular Entry. In the event of Entry invalidation, Entrant will no longer be eligible to participate in the Contest, and will have no recourse or other opportunity to submit an Entry.

- You agree not to make any claim against The Henry Ford, PBS, its affiliates, subsidiaries, licensees, and assigns as a result of your participation in this promotion, any use of or decision not to use the Materials or part of them, including, but not limited to, any claim that such use invades any right of privacy, publicity, or both.
- You understand that, other than the opportunity to enter this Contest, you will not be paid any money or receive any other consideration or form of compensation for giving PBS these rights. You further understand you will not be reimbursed for any costs you may have incurred in connection with submitting the Materials.
- You represent that you are at least 18 years old at the time you submit your Entry and otherwise satisfy the Entry and Eligibility Requirements described in these Official Rules.

8. Privacy: Any information collected in connection with this Contest is solely for the purpose of Contest administration and will be collected, used, and maintained according to PBS’s Privacy Policy which can be found at: http://www.pbs.org/about/policies/privacy-policy/.

9. Request for Winners List and Official Rules: Requests for Winners List and/or Official Rules can be made to teacherinnovatorawards@gmail.com

10. Disputes: This Contest and these Official Rules shall be governed by the laws of the state of VIRGINIA. Any and all claims or disputes arising out of or in connection with this Contest shall be made individually and in no event in the form of a class action, and shall be made in the applicable state or federal court in the city of ARLINGTON, VA without regard to any conflicts of law principles.

Multimedia resources & Professional Development for America's PreK-12 educators.
Appendix B

Initial Email to Contact Participants

-----Email Message-----
From: Davis, Erin L  
Sent: To be determined  
To: TIA winners  
Subject: Request for information regarding teaching with technology

Dear TIA winner name,

My name is Erin Davis and I am an Instructional Technology Specialist for Atlanta Public Schools. I am also a Ph.D. candidate in Instructional Technology at Georgia State University. My dissertation research, under the advisement of Dr. Laurie Brantley-Dias, will study the planning strategies of expert technology-integrating teachers in hopes of improving the planning practices of non-technology-using teachers. As an expert technology-using teacher and previous PBS Teacher Innovation Award winner, I would like to invite you to participate in a study to learn about your planning practices. I hope to consult with you to figure out the best planning practices in technology integration and how your skills, strategies, and knowledge can be captured to assist teachers who struggle with technology integration.

Being an educator myself, I appreciate the importance of technology integration in teaching and learning. As an educator of teachers, many of whom struggle with integrating technology, I strive to show them creative and practical ways to incorporate technology into the classroom practices. However, the research on teacher planning, specifically teacher planning for technology integration needs updating. There is a lack of information on how expert technology-integrating teachers like you plan for instruction. What does exist is literature related to how teachers should plan which may not reflect what you are actually doing in your classrooms. Hence the current research may not be aligned with actual classroom practice.

With your help, I would like to investigate and document the planning strategies of technology-integrating teachers. I believe that by identifying your skills, strategies, and knowledge would benefit teachers who have difficulty integrating technology.

I hope that you will be willing to share your insight and experiences. I would like to survey you about the classes you teach, technology available, and how you describe yourself as a planner and then talk with you a few times in an online interview format for approximately 90 minutes each time via video conferencing (e.g. Skype or Google Hangout). Of course, your participation is completely voluntary. Please let me know if you have any questions.

Thank you for considering this request. See the attached consent form for detailed description of the purpose and procedures of this study. If you are interested, please sign the consent form and either fax it to 404.XXX.XXX, mail it to the address below, or scan and email it back to edavis@myemail.gsu.edu. Thank you again for your time and consideration.

Sincerely,  
Erin Davis  
XXXX Research St NE, Atlanta, GA 30306  
404.XXX.XXX
Appendix C

Informed Consent

Georgia State University
Department of Instructional Technology
INFORMED CONSENT

Title: Teacher planning problem space of expert technology integrating teachers
Principal Investigator: Laurie Brantley-Dias, PI
Erin Leslie Davis, Student PI

I. Purpose:
You are invited to participate in a research project. The purpose of this study is to describe the planning strategies expert teachers use in designing technology-integrated instruction. You have been invited to participate in this study because you are a recipient of the PBS Teacher Innovation Award. A total of 32 participants will be recruited to take a 30-minute survey and then partake in three online interviews for approximately 90 minutes each via video conferencing. Participation in the entire study (survey and interviews) will take approximately 5 hours and 45 minutes of your time over an 18-week period.

II. Procedures:
If you decide to participate, you will be asked to email lesson plans and technology artifacts (e.g. presentations and rubrics), take an online survey regarding background information related to your knowledge of teaching and technology as well as how you plan lessons, and participate in three recorded online interviews to gain information about your implementation of technology in your classroom and lesson design process.

You will receive an introductory email that also includes a link to a survey as well as an attached consent form. The survey is to obtain demographic information and to gauge technology integration knowledge. Participation in the recruitment material will take approximately 10 minutes and the survey will take approximately 30 minutes to complete. Thirty-two participants will be recruited to take part in a survey and then participate in three interviews lasting approximately 90 minutes each time conducted online via videoconferencing using Google Hangout throughout the Fall 2013 semester.

All three interviews will be conducted via Google Hangout and will last approximately 90 minutes each. The first interview topic will be to discuss your TIA winning entry. The second interview topic will be about a different lesson plan you have created for instruction and the third interview topic will involve an on-the-spot planning given a particular standard in their respective content areas. All interviews will only be recorded if you grant permission. You may also be asked to email some of your lesson plans and corresponding technology artifacts. This will take approximately 5 minutes per email.

III. Risks:
In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:
Participation in this study may benefit you personally. Overall, we hope to gain information about
the lesson planning process of expert technology integrating teachers. Often the teacher planning process is mental. By articulating this process during your involvement in this study, you may be able to pinpoint specific aspects of their planning that contribute to successful implementation and in doing so, may be better able to articulate them to their peers and assist those who struggle with technology integration.

V. Voluntary Participation and Withdrawal:
Participation in research is voluntary. You do not have to be in this study. If you decide to be in the study and later change your mind, you have the right to drop out at any time. You may also decide not to answer interview questions or refuse to have the videoconference recorded.

VI. Confidentiality:
We will keep your records private to the extent allowed by law. Laurie Brantley-Dias and Erin Leslie Davis will have access to the information you provide. Information may also be shared with those who make sure the study is done correctly (GSU Institutional Review Board, the Office for Human Research Protection (OHRP). We will use a pseudonym rather than your name on study records. The information you provide will be stored in a password-protected directory on the principal researcher’s computer. Audio and video recording and transcriptions of these will also be stored in a password-protected directory on the principal researcher’s computer. The transcribed data may also be printed. Any printed copies of files will be kept in a lockable cabinet. Your name and other facts that might point to you will not appear when we present this study or publish its results. The findings will be summarized and reported in group form. You will not be identified personally.

VII. Contact Persons:
Contact Dr. Laurie B. Dias at 404.413.8422 or lbdias@gsu.edu or Erin Davis 404.494.0034 or edavis8@student.gsu.edu if you have questions, concerns, or complaints about this study. You can also call if think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu if you want to talk to someone who is not part of the study team. You can talk about questions, concerns, offer input, obtain information, or suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

VIII. Copy of Consent Form to Subject:
We will give you a copy of this consent form to keep. If you are willing to volunteer for this research sign below.

Participant _____________________________ Date __________

Principal Investigator or Researcher Obtaining Consent _____________________________ Date __________

Regarding audio and video recording, check the appropriate box and sign.

☐ I am willing to be recorded ☐ I am NOT willing to be recorded

Participant _____________________________ Date __________
Appendix D

Teacher Planning Problem Space Survey

TPPS Expertise

*1. Background information:

Name: 
Age: 
Highest education level achieved: 
Number years taught: 
Main subject(s) taught: 
Average class size: 
Grade level(s) taught: 
If middle or high school, list courses taught: 

*2. Computer access: Please indicate the number of computers according to their location/mobility and Internet access.

<table>
<thead>
<tr>
<th>Number of computers</th>
<th>Internet access?</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Yes</td>
<td>Not available</td>
</tr>
<tr>
<td>1-5</td>
<td>Yes</td>
<td>Rarely</td>
</tr>
<tr>
<td>6-10</td>
<td>Yes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>11-15</td>
<td>Yes</td>
<td>Often</td>
</tr>
<tr>
<td>16-20</td>
<td>No</td>
<td>Never</td>
</tr>
<tr>
<td>21-25</td>
<td>Not applicable</td>
<td>Occasionally</td>
</tr>
<tr>
<td>26-30</td>
<td>No</td>
<td>Usually</td>
</tr>
<tr>
<td>31+</td>
<td>No</td>
<td>Occasionally</td>
</tr>
</tbody>
</table>

a. Computers located in your classroom everyday
b. Computers that can be brought into your classroom (e.g., laptops on carts)
c. Computers in the computer lab

*3. For each of the devices below:
Choose one option for availability and one option for use (for a total of two selections per row):

AVAILABILITY: Indicate its availability to you. Include only devices provided by the school or district.

USE: For devices that are available to you, indicate how frequently they are used for instruction during your class(es). Include only devices provided by the school or district.

a. LCD or DLP projector
b. Video conference
<table>
<thead>
<tr>
<th>unit</th>
<th>Not AVAILABLE</th>
<th>AVAILABLE</th>
<th>Always</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>USE</th>
<th>Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Interactive whiteboard (e.g., SMART Board, Activboard)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. Classroom response system</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Digital camera (still or video)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f. MP3 player/iPod</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>g. Document camera</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>h. Handheld device (e.g., iPad, iPod, Windows Surface, other tablet)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

List any devices used that were not addressed above:

*4. In general, how frequently do your students perform the following activities using educational technology during your class(es)? Select “not applicable” for activities that do not apply to your students.

<table>
<thead>
<tr>
<th>activity</th>
<th>Not available</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Prepare written text (e.g., word processing, desktop publishing)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. Create or use graphics or visual displays (e.g., graphs, diagrams, pictures, maps)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Learn or practice basic skills (e.g., reading or math skills)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. Conduct research (e.g., Internet searching, using reference materials on CD-ROM)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Correspond with others (e.g., students, teachers, experts) via email, network, or Internet</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f. Contribute to blogs or wikis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>g. Use social networking websites</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>h. Solve problems, analyze data, or perform calculations</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>i. Conduct experiments or perform measurements</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>j. Develop and present multimedia presentations</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>k. Create art, music, movies, or webcasts</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>l. Develop or run demonstrations, models, or simulations</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
m. Design and produce a product (e.g., computer-aided manufacturing)

Not available  Never  Rarely  Sometimes  Often

*5. In general, how frequently do you use the following for classroom preparation, instruction, or administrative tasks?

a. Word processing software
b. Database management software (e.g., Access)
c. Spreadsheets and graphing programs (e.g., Excel)
d. Software for managing student records
e. Software for desktop publishing
f. Graphics, image-editing software (e.g., Photoshop, KidPix)
g. Software for making presentations (e.g., PowerPoint, Keynote)
h. Software for administering tests
i. Simulation and visualization programs
j. Drill/practice programs/tutorials
k. Subject-specific programs
l. The Internet
m. Blogs and/or wikis
n. Social networking websites

List professional learning opportunities for educational technology (e.g., workshops, courses, coordinated workgroups) you have attended in the past three years:

*6. How do you define technology integration?

*7. School-based lesson plan requirements

a. Does your school require you to submit lesson plans?
b. Do they require a specific format for these plans?
c. Do you receive feedback on lesson plans you turn in?  
  Yes  No  Not applicable

d. Do have time in your school schedule specifically for collaborative planning?  
  Yes  No  Not applicable

e. Do you use this scheduled time to plan collaboratively?  
  Yes  No  Not applicable

f. Do you have time in your school schedule specifically for individual planning?  
  Yes  No  Not applicable

g. Do you use this scheduled time to plan individually?  
  Yes  No  Not applicable

*8. Using the following terms to indicate which best describes you as a planner for the following situations.

Flow: general planner, leaving the details to the implementation process as they emerge

Flexible: detailed planner based on assumption that change could take place during the implementation

Fulfiller: detailed planner, organized and structured during implementation

<table>
<thead>
<tr>
<th></th>
<th>Flow</th>
<th>Flexible</th>
<th>Fulfiller</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. When writing daily lesson plans, I consider myself a planner.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>b. When writing weekly lesson plans, I consider myself a planner.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>c. When writing unit lesson plans, I consider myself a planner.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>d. When I include technology as part of a lesson plan, I consider myself a planner.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>e. When I plan a vacation, I consider myself a planner.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

*9. Rank the order in which you make decisions about the following eight categories when planning a lesson.

(if you consider two items simultaneously, use the same number for rank)

Goals, aims, outcomes, or purposes
Subject matter to be taught (e.g. identification of facts, events, or other aspects)
Type of learning activity, activities, or experience to be used
Resources to be used (e.g. books, video, Internet)
Student readiness for particular lesson(s)
How to determine effectiveness of a lesson
Teaching strategies and teacher behaviors
How to arrange the teaching-learning environment (e.g. student grouping, use of space, use of time)

10. If you ranked "other" as part of the order in which you make decisions about planning a lesson, please elaborate here:
Appendix E

Interview Prompts

Interview 1

Hi ______________. May I call you by your first name? So great to meet you! Thank you again for agreeing to be interviewed. I wanted to remind you that I am recording our conversations. Is that ok? Let me tell you a little bit about the project…I know you have read about it ….here is a brief description….I am interested in the planning practices of expert technology integrators. I found you through your PBS teacher innovation award. Your entry is really great! I want to ask you some questions about that later but first I wanted to ask you some questions about the survey you completed.

In looking at the question about how you define technology integration…
How do you see technology fitting into your teaching? (The role of technology in your classroom?) How do you see it fitting into your kids’ learning? Do you think it is important to plan for using technology? Why?

Another question referred to school based lesson plan requirements…
See survey data: If no….do you write lesson plans for yourself? Do you use your planning time as school to plan? Do you plan with any other teachers?

If yes…tell me about…The lesson plans you submit….What is the format for these plans? Do you have a template? Would you mind sending it to me? You receive feedback on lesson plans you turn in? What is the feedback regarding? Do you do anything with the feedback?

Regarding the question about words that describe you as a planner: FLOW, FLEXIBLE, FULFILLER. (Read definitions if they ask for them….). Tell me about. WHY?

a. When writing daily lesson plans, I consider myself a __________ planner.
b. When writing weekly lesson plans, I consider myself a __________ planner.
c. When writing unit lesson plans, I consider myself a __________ planner.
d. When I include technology as part of a lesson plan, I consider myself a __________ planner.

The last question from the survey dealt with the order in which you make decisions about planning a lesson:

• OBJECTIVES: Goals, aims, outcomes, or purposes
• CONTENT: Subject matter to be taught (e.g. identification of facts, events, or other aspects)
• ACTIVITIES: Learning activity, activities, or experience to be used
• RESOURCES: Resources to be used (e.g. books, video, Internet)
• STUDENT CHARACTERISTICS: Student readiness for particular lesson(s), special needs
• EVALUATION: How to determine effectiveness of a lesson
• STRATEGIES: Teaching strategies, pedagogy, and, teacher behaviors
• ENVIRONMENT: Teaching-learning environment (e.g. student grouping, use of space, use of time)

You chose ______________________ first….it this the same when you use technology in a lesson? Tell me more about…..Remember back to your PBS award video. Questions depend on the video. If it is a lesson: Tell me a bit about how you planned for this lesson….

Interview 2

Lesson Title: ________________________________________________

Prior to v-interview: Request written lesson plan of a lesson you are about to teach

Questions:
• Tell me about the topic for this lesson?
• Tell me about any teaching strategies will you use?
• It looks like you present/represent the content like this: __________________________________________ How did you decide to present/represent the content the way you did? [CE: Knowledge/Construction]
• Tell me about the technology or other resources you will use? [CE: Knowledge/Construction]
• Describe how did you decided to use the technology way you did? [CE: Knowledge/Construction]
• Describe your classroom/lab in which the lesson took place – how are desks arranged, how are the students arranged?. [TE: Physical problem context]
• Tell me about your plan for teaching this lesson?
  • How would you describe what you wanted the students to do? [CE: Conceptual context (maybe)]
  • How would you describe what the students could do? [CE: Conceptual context (maybe)]
  • How will you communicate to the students what they are to do? [CE: Routines]
  • Did you create any technology artifacts (models, presentations, rubrics) for students as part of the lesson plan? [CE: Knowledge]
• Have you delivered this lesson more than once? [CE: Experience]
  o Was it modified based on anything that happened during implementation? [CE: Adaptation]
• What do you think will be the most successful part about of this lesson? Why? [CE: Experience]
• How do you know that this lesson plan will work? [CE: Investigation/Experience]
• Describe why you considered them in that order? [CE: Elaboration – construction]
Interview 3

Name ______________________________  Date __________________________

- What was your motivation for applying for the PBS Teacher Innovation Award?
- When does your school day start and finish?
- Tell me a little bit about a typical day – schedule-wise for you…
- Do you see all your students in one day? Every other day? Once a week?
- How many kids do you see in one day?
- How much time do you have for planning on a daily basis?
- When do you do most of your planning? Why do you think this is so?
- Do you prefer to collaboration or plan alone? Why/why not?
- Describe your classroom. What does it look like?
- Talk a little about your students. How would you describe them in terms of abilities, demographics, class cultures for each class?
- Talk a little bit about the role technology plays in your classroom. How would you describe where it fits and where it doesn’t?
- Why use technology at all?
- How would describe what you know about technology – or want to know about technology? Describe yourself in terms as a student of technology instead of a teacher using it. How do you like to learn it, etc.?
- What is one of the most valuable things you have learned about teaching with technology?
- What advice would you give another teacher who was just starting out about teaching with technology?

I’m going to give you a content standard/topic and I would like you to talk me through your process for how you might plan a lesson using it….say I’m a brand new teacher and you are taking me through how you would teach this – planning for one lesson…. First of all tell me what this standard means in terms of content – since I am not necessarily familiar with it.
Appendix F

Coding Frame Development Process

Table F 1  
*Comparison of initial codes to working codes*

<table>
<thead>
<tr>
<th>Initial Codes</th>
<th>Working Codes</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Assessment</td>
<td>None</td>
</tr>
<tr>
<td>Background</td>
<td>Background</td>
<td>None</td>
</tr>
<tr>
<td>Barrier/ Overcome Barrier</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Collaboration</td>
<td>None</td>
</tr>
<tr>
<td>Content</td>
<td>Content</td>
<td>None</td>
</tr>
<tr>
<td>Displaying Student Work</td>
<td>Display Student Work</td>
<td>None</td>
</tr>
<tr>
<td>Experience</td>
<td>Experience</td>
<td>None</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Flexibility</td>
<td>None</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Knowledge</td>
<td>None</td>
</tr>
<tr>
<td>Planning Process</td>
<td>Planning Process</td>
<td>None</td>
</tr>
<tr>
<td>Potential/Change/Possibilities</td>
<td>Possibilities</td>
<td>None</td>
</tr>
<tr>
<td>Reference to Broader Content Field</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>Reflection</td>
<td>Reflection</td>
<td>None</td>
</tr>
<tr>
<td>Resources</td>
<td>Resource</td>
<td>None</td>
</tr>
<tr>
<td>Routine</td>
<td></td>
<td>Added</td>
</tr>
<tr>
<td>Role of Technology</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>School Organization</td>
<td>School Organization</td>
<td>None</td>
</tr>
<tr>
<td>Soliciting Resources</td>
<td>Solicit Resources</td>
<td>None</td>
</tr>
<tr>
<td>Student Experience</td>
<td>Student Experience</td>
<td>None</td>
</tr>
<tr>
<td>Teaching</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>Teachers Teaching Teachers</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>Teaching Environment</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>Teaching Strategy</td>
<td></td>
<td>Added</td>
</tr>
<tr>
<td>Technology Integration</td>
<td>Technology Integration</td>
<td>None</td>
</tr>
<tr>
<td>Time</td>
<td>Time</td>
<td>None</td>
</tr>
<tr>
<td>Time Mgmt</td>
<td></td>
<td>Omitted</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>Troubleshoot</td>
<td>None</td>
</tr>
<tr>
<td>Unsure</td>
<td></td>
<td>Added</td>
</tr>
</tbody>
</table>
### Table F 2

**Working coding frame**

<table>
<thead>
<tr>
<th>Code</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment</strong></td>
<td>Description: Participant mentions assessment of student learning.</td>
</tr>
<tr>
<td></td>
<td>Features: The assessment may be formative or summative, informal or formal.</td>
</tr>
<tr>
<td></td>
<td>Assessments may use technology or not – anything to evaluate student learning</td>
</tr>
<tr>
<td></td>
<td>Indicators: Tests, labs, assignments, classwork, homework, quizzes, asks questions.</td>
</tr>
<tr>
<td></td>
<td>Rule/memo: This may become a teaching strategy but for now it is separate.</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>Description: Participant mentions personal background information.</td>
</tr>
<tr>
<td></td>
<td>Features: How a participant became a teacher, educational background.</td>
</tr>
<tr>
<td></td>
<td>Indicators: Came into teaching, feelings about teaching, degree information.</td>
</tr>
<tr>
<td></td>
<td>Rule/memo: This is not background information about the school – that is school organization.</td>
</tr>
<tr>
<td><strong>Collaboration</strong></td>
<td>Description: The participant mentions working with another or other teachers to create a lesson – or describes the process of working with other teachers to create instruction.</td>
</tr>
<tr>
<td></td>
<td>Features: Working with another teacher.</td>
</tr>
<tr>
<td></td>
<td>Indicators: Planning together, team meetings, meeting with other teachers to plan, collaboration. The word “we” in reference to a teacher</td>
</tr>
<tr>
<td></td>
<td>Rule/memo: The decision to code as collaboration should follow the rule most simply put that it includes the word collaboration, or team planning. This does not necessarily mean a unit plan submitted to a group. This is different from feedback from teacher say in a team meeting or a teacher discussion.</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>Description: Participant mentions content (art, math, science, reading).</td>
</tr>
<tr>
<td></td>
<td>Features: Specific knowledge related to a subject.</td>
</tr>
<tr>
<td></td>
<td>Indicators: Absolute value, monochromatic colors, Common Core Standards.</td>
</tr>
<tr>
<td></td>
<td>Rule/memo: This code is different from technology integration and solely focused on the academic content.</td>
</tr>
<tr>
<td><strong>Display student work</strong></td>
<td>Description: Participant mentions displaying or creating an audience for student work.</td>
</tr>
<tr>
<td></td>
<td>Features: Put work online or collect in a digital format.</td>
</tr>
<tr>
<td></td>
<td>Indicators: Words like posting online, digital portfolios.</td>
</tr>
<tr>
<td></td>
<td>Rule/memo: This is different than a student doing a presentation as part of a lesson. It is not using technology to present.</td>
</tr>
<tr>
<td><strong>Experience</strong></td>
<td>Description: This should made distinct from KNOWLEDGE. Comments about what has worked and what has not based on what has happened in class – or a personal experience that contributed to something? Experiencing something before the kids do it…..testing it out before the kids do it.</td>
</tr>
<tr>
<td></td>
<td>Features: Pilot testing, learning from the past.</td>
</tr>
<tr>
<td></td>
<td>Indicators: In the past, pilot.</td>
</tr>
<tr>
<td></td>
<td>Rule/memo: This is not learning about a piece of software or professional learning.</td>
</tr>
<tr>
<td>Code</td>
<td>Information</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Participant mentions flexibility</td>
</tr>
<tr>
<td>Description</td>
<td>Changes lessons based on something that happens – maybe in their control or</td>
</tr>
<tr>
<td></td>
<td>out of their control.</td>
</tr>
<tr>
<td>Features</td>
<td>Flexibility</td>
</tr>
<tr>
<td>Indicators</td>
<td>This maybe similar to possibilities [change], however it is different this is</td>
</tr>
<tr>
<td></td>
<td>flexibility within a lesson rather than the potential of technology or changing</td>
</tr>
<tr>
<td></td>
<td>a lesson after implementing.</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Participant mentions their knowledge or knowing something.</td>
</tr>
<tr>
<td>Description</td>
<td>Features: professional learning, learning software to teach a lesson.</td>
</tr>
<tr>
<td>Features</td>
<td>Taught myself, I learned, training.</td>
</tr>
<tr>
<td>Indicators</td>
<td>This is different than student learning.  It is the knowledge that the teacher</td>
</tr>
<tr>
<td></td>
<td>possesses or attains to teach a lesson.</td>
</tr>
<tr>
<td>Planning process</td>
<td>Participant mentions their planning process.</td>
</tr>
<tr>
<td>Description</td>
<td>Features: how to get ready to deliver a lesson.</td>
</tr>
<tr>
<td>Features</td>
<td>Practice, pilot, big ideas, start with the end in mind.</td>
</tr>
<tr>
<td>Indicators</td>
<td>Pay attention to whether this falls under teaching strategies or routines.</td>
</tr>
<tr>
<td>Possibilities</td>
<td>Participant mentions possibilities of technology or changes in teaching</td>
</tr>
<tr>
<td>Description</td>
<td>practices.</td>
</tr>
<tr>
<td>Features</td>
<td>Features: looking at instruction in a different way because of technology.</td>
</tr>
<tr>
<td>Indicators</td>
<td>Words like change, potential, possibilities.</td>
</tr>
<tr>
<td>Rule/memo</td>
<td>This category has to do with taking an technology application and using it to</td>
</tr>
<tr>
<td></td>
<td>change instruction or becoming complacent in one’s practice and needing to</td>
</tr>
<tr>
<td></td>
<td>change.</td>
</tr>
<tr>
<td>Reflection</td>
<td>Participant mentions thinking about or reflecting on teaching practices</td>
</tr>
<tr>
<td>Description</td>
<td>(improving a lesson), opinions about instruction (doing this or that is a waste</td>
</tr>
<tr>
<td></td>
<td>of time or beneficial), and descriptions about teaching strategies in general</td>
</tr>
<tr>
<td>Features</td>
<td>(rather than tied to a specific lesson).</td>
</tr>
<tr>
<td>Indicators</td>
<td>Not referring to a specific situation</td>
</tr>
<tr>
<td>Rule/memo</td>
<td>These are thinking and feeling statements (similar to what beliefs and</td>
</tr>
<tr>
<td></td>
<td>attitudes would normally be). Separate from describing an implementation</td>
</tr>
<tr>
<td></td>
<td>process for a specific example – refers to something that is a routine or</td>
</tr>
<tr>
<td></td>
<td>pattern – or something the participant does all the time.</td>
</tr>
<tr>
<td>Resource</td>
<td>Participant mentions a resource used in a lesson FREE OF THE CONTEXT FOR USE.</td>
</tr>
<tr>
<td>Description</td>
<td>It may be a technology or non-technology resource.</td>
</tr>
<tr>
<td>Features</td>
<td>Technology resource that is brand specific: keynote, ipads; Technology</td>
</tr>
<tr>
<td>Indicators</td>
<td>resources that is non-brand specific: interactive white board; Non-technology</td>
</tr>
<tr>
<td></td>
<td>resource: dry-erase markers, graph paper, textbooks, printed material.</td>
</tr>
<tr>
<td>Code</td>
<td>Information</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Rule/memo:</strong></td>
<td>This is not technology integration (resource in context).</td>
</tr>
<tr>
<td><strong>Routine</strong></td>
<td><strong>Description:</strong> Participant mentions something that regularly occurs either during teaching of a lesson or in the classroom in general.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Negotiated terms/language from class.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>We call them....&quot;spicy problems&quot; or &quot;magic touch.&quot; Any references to routine terms in class.</td>
</tr>
<tr>
<td><strong>Rule/memo:</strong></td>
<td>The term is part of a routine. How the term is used is part of the student experience. Don't confuse the two. This was relocated from student experience.</td>
</tr>
<tr>
<td><strong>School organization</strong></td>
<td><strong>Description:</strong> Participant mentions school-related rules and roles they play within a school.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Refers to scheduling, requirements about lesson plans and planning, support personnel for technology or in class</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Words such as: unit plans, weekly plans, teaching other teachers in the school -- in the context that the teachers rely on this person for tech help.</td>
</tr>
<tr>
<td><strong>Rule/memo:</strong></td>
<td>This may become school culture. This is different that references to time (for teaching) and time management but does include references to common planning time and meetings for common planning.</td>
</tr>
<tr>
<td><strong>Solicit resources</strong></td>
<td><strong>Description:</strong> Participant mentions seeking outside help for obtaining resources for students/classroom.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Raise money</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Fundraising, money for resources.</td>
</tr>
<tr>
<td><strong>Rule/memo:</strong></td>
<td>Uses technology or other means to raise money for classroom. This will become part of resources</td>
</tr>
<tr>
<td><strong>Student experience</strong></td>
<td><strong>Description:</strong> Participant mentions what the students experienced during a lesson.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Student motions: crying, excitement, panic. Talking about student products and student engagement.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Mentions the word “we” when describe a lesson -- describes the lesson in terms of a shared experience -- including the students or considering the student experience and goes through it with the student. The words: engagement.</td>
</tr>
<tr>
<td><strong>Rule/memo:</strong></td>
<td>This is different from describing a lesson or talking about a teaching strategy. The negotiated language may become a separate code but for now (9.28.13) it is a routine.</td>
</tr>
<tr>
<td><strong>Teachers teaching teachers</strong></td>
<td><strong>Description:</strong> Participant mentions teaching other teachers or sharing knowledge with other teachers.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Conducts workshops.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Sharing ideas.</td>
</tr>
<tr>
<td><strong>Rule/memo:</strong></td>
<td>This is not to be confused with professional development - this is not participant learning. Refers to other teachers -- counting on the participant to assist or the participant is compelled to assist other teachers or share their knowledge within their school, time allotted for class (?).</td>
</tr>
<tr>
<td>Code</td>
<td>Information</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Teaching strategy</td>
<td>Description: Participant mentions a technique used for teaching students. Features: Catering to learning styles of students, additional teaching methods to reach struggling students, small groups, etc. Indicators: Groups, modeling, scaffolding… Rule/memo: This is a broad category of strategies that teacher use to teach students. It will have several subcategories.</td>
</tr>
<tr>
<td>Technology integration</td>
<td>Description: Technology integration requires: “an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students’ prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (Koehler &amp; Mishra, 2009, p. 66).” Features: Mentions technology and benefit for students, using technology but teaching content area – less of a tech teacher, using tech to do something couldn’t do otherwise. Indicators: Using technology specific to content Rule/memo: This is a teaching strategy – but a special one.</td>
</tr>
<tr>
<td>Time</td>
<td>Description: Participant mentions time as a factor in teaching or provides a way to management time in a classroom. Eventually time management may become a teaching strategy but for now (9.28.13) all references to time will be together. Features: Any reference to time or lack of Indicators: Class times, time with students, time planning, strategies to save time, using technology to save time. Rule/memo: Any mention of time should go in here.</td>
</tr>
<tr>
<td>Troubleshoot</td>
<td>Description: Participant mentions solving problems related to technology OR non-technology things that can go wrong when implementing a lesson. Features: Technology examples include a malfunction with the resource. A non-technology example includes time issues – running out of time or finishing early. Indicators: Pilot, troubleshooting, testing out, etc. Rule/memo: Piloting a project is also troubleshooting. Include what can go wrong in a lesson. Include strategies for problem solving….such as over-planning, piloting. This may overlap with teaching strategies but needs to be labeled separately for now (9.28.13).</td>
</tr>
<tr>
<td>Unsure</td>
<td>Description: Participant mentions something that seems important but it does not fit neatly into an existing code</td>
</tr>
</tbody>
</table>
Table F 3

*Summary of reliable and unreliable codes after peer review*

<table>
<thead>
<tr>
<th>Code</th>
<th>Status</th>
<th>Reason(s) for unreliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>Unreliable</td>
<td>Peer reviewer had questions about which code to use (Background or Reflection) for beliefs or philosophy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peer reviewer suggested a subcode of Community for the Background code.</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Unreliable</td>
<td>Peer reviewer coded teacher communicating with another teacher, but the intention of the code was teachers working together.</td>
</tr>
<tr>
<td>Content</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Display student work</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>Unreliable</td>
<td>Peer reviewer coded Experience as Background</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>Unreliable</td>
<td>Peer reviewer suggested Knowledge category be broken down into Personal Knowledge versus Professional Knowledge.</td>
</tr>
<tr>
<td>Planning process</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Possibilities</td>
<td>Unreliable</td>
<td>Peer reviewer coded student possibilities, but the intention of the code was teacher possibilities</td>
</tr>
<tr>
<td>Reflection</td>
<td>Unreliable</td>
<td>The codebook used the word feelings in both Background and Reflection codes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peer-reviewer suggested an additional code called Beliefs</td>
</tr>
<tr>
<td>Resource</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Routine</td>
<td>Unreliable</td>
<td>Peer reviewer was unsure when to use this code.</td>
</tr>
<tr>
<td>School organization</td>
<td>Unreliable</td>
<td>Peer reviewer suggested an additional code called Culture.</td>
</tr>
<tr>
<td>Solicit resources</td>
<td>Untested</td>
<td></td>
</tr>
<tr>
<td>Student experience</td>
<td>Unreliable</td>
<td>Peer reviewer asked if the Student experience was not connected to a lesson, which category would it fall under?</td>
</tr>
<tr>
<td>Teachers teaching</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>teachers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching strategy</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>Unreliable</td>
<td>Peer reviewer had questions about whether an</td>
</tr>
<tr>
<td>Code</td>
<td>Status</td>
<td>Reason(s) for unreliability</td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>integration</td>
<td></td>
<td>excerpt was a belief about technology integration or this code.</td>
</tr>
<tr>
<td>Time</td>
<td>Reliable</td>
<td></td>
</tr>
<tr>
<td>Troubleshoot</td>
<td>Unreliable</td>
<td>Peer reviewer coded student troubleshooting, but the intention of the code was teacher troubleshooting</td>
</tr>
</tbody>
</table>

Note: Status = reliable, unreliable, or untested: Reliable = peer reviewer coded similarly to the primary researcher. Unreliable = peer reviewer either coded an excerpt differently or had questions about which code to use. Untested = peer-reviewer did not code the transcripts using the respective code.

Table F 4

*Tested coding frame*

<table>
<thead>
<tr>
<th>Code</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment</strong></td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td>Participant mentions assessment of student learning.</td>
</tr>
<tr>
<td>Features:</td>
<td>The assessment may be formative or summative, informal or formal.</td>
</tr>
<tr>
<td></td>
<td>Assessments: use technology or not – anything to evaluate student learning.</td>
</tr>
<tr>
<td>Indicators:</td>
<td>Tests, labs, assignments, classwork, homework, quizzes, asks questions.</td>
</tr>
<tr>
<td>Rule(s):</td>
<td>This may become a teaching strategy but for now it is separate.</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td>Participant mentions personal background information.</td>
</tr>
<tr>
<td>Features:</td>
<td>How a participant became a teacher, educational background.</td>
</tr>
<tr>
<td>Indicators:</td>
<td>Facts about background, degree information, certificates, awards.</td>
</tr>
<tr>
<td>Rule(s):</td>
<td>This is NOT thoughts, feelings, or beliefs – those should be coded as Reflection. This is not background information about the school – that is school organization. This is not background information about the students or student stories – that is student experience.</td>
</tr>
<tr>
<td><strong>Collaboration</strong></td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td>Mentions working with another or other teachers to create a lesson – or describes the process of working with other teachers to create instruction.</td>
</tr>
<tr>
<td>Features:</td>
<td>Working with another teacher.</td>
</tr>
<tr>
<td>Indicators:</td>
<td>Common planning, planning together, team meetings, meeting with other teachers to plan, collaboration. The word “we” in reference to a teacher.</td>
</tr>
<tr>
<td>Rule(s):</td>
<td>To code as Collaboration it have the word collaboration, or team planning. This does not necessarily mean a unit plan submitted to a group. This is different from feedback from teacher say in a team meeting – find example. This does NOT include teacher communication. Teacher communication, if sharing information should be coded at Teacher teaching teachers. If students are collaborating, the excerpt should be coded under Teaching strategies if it is used in the context of a lesson or as Student experience if students are working together without direction of the teacher.</td>
</tr>
<tr>
<td>Code</td>
<td>Information</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Content             | **Description:** Participant mentions content (art, math, science, reading).  
|                     | **Features:** Specific knowledge related to a subject.  
|                     | **Indicators:** Absolute value, monochromatic colors, Common Core Standards.  
|                     | **Rule(s):** This code is different from technology integration and solely focused on the academic content.                                      |
| Display student work| **Description:** Participant mentions displaying or creating an audience for student work.  
|                     | **Features:** Put work online or collect in a digital format.  
|                     | **Indicators:** Words like posting online, digital portfolios.  
|                     | **Rule(s):** This is different than a student doing a presentation as part of a lesson. It is not using technology to present.               |
| Experience          | **Description:** This should me made distinct from KNOWLEDGE. Comments about what has worked and what has not based on what has happened in class – a personal experience that contributed to teaching. Experiencing something before the kids do it or testing it out before the kids do it.  
|                     | **Features:** Pilot testing, learning from the past.  
|                     | **Indicators:** In the past, pilot.  
|                     | **Rule(s):** This is NOT learning about a piece of software or professional learning. The decision to code something as Experience is determined by learning from a classroom experience or a personal experience that directly impacted the way the teacher behaves. If participant mentions a fact about something that occurred in the past not connected to a classroom, code as Background. |
| Flexibility         | **Description:** Participant mentions flexibility.  
|                     | **Features:** Changes lessons based on something that happens – maybe in their control or out of their control.  
|                     | **Indicators:** Flexibility.  
|                     | **Rule(s):** This maybe similar to Possibilities [change], however it is different this is flexibility within a lesson rather than the potential of technology or changing a lesson after implementing. |
| Knowledge           | **Description:** Participant mentions their knowledge or knowing something.  
|                     | **Features:** Professional knowledge, learning software to teach a lesson.  
|                     | **Indicators:** Taught myself, I learned, training.  
|                     | **Rule(s):** This is different than student learning. It is the knowledge that the teacher possesses or attains to teach a lesson. This category is too broad, but the category will be split in a later stage of analysis. |
| Planning process    | **Description:** Participant mentions their planning process.  

<table>
<thead>
<tr>
<th>Code</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features:</strong></td>
<td>How to get ready to deliver a lesson.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Practice, pilot, big ideas, start with the end in mind.</td>
</tr>
<tr>
<td><strong>Rule(s):</strong></td>
<td>Pay attention to whether this falls under teaching strategies or routines.</td>
</tr>
<tr>
<td><strong>Possibilities</strong></td>
<td>Participant mentions possibilities of technology or changes in teaching practices.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Features: looking at instruction in a different way because of technology.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Words like change, potential, possibilities.</td>
</tr>
<tr>
<td><strong>Rule(s):</strong></td>
<td>This category has to do with the teacher taking a technology application and using it to change instruction or becoming complacent in one’s practice and needing to change. If the students explore the possibilities, it should be coded as Student experience.</td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>Participant mentions thinking about or reflecting on teaching practices (improving a lesson), opinions about instruction (doing this or that is a waste of time or beneficial), and descriptions about teaching strategies in general (rather than tied to a specific lesson).</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>Not referring to a specific situation</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>I feel statements; I think statements; thoughts about teaching a content area in general (bigger picture).</td>
</tr>
<tr>
<td><strong>Rule(s):</strong></td>
<td>These are thinking and feeling statements (similar to what beliefs and attitudes would normally be). Separate from describing an implementation process for a specific example – refers to something that is a routine or pattern – or something the participant does all the time. Beliefs should be coded as Reflection.</td>
</tr>
<tr>
<td><strong>Resource</strong></td>
<td>Participant mentions a resource used in a lesson FREE OF THE CONTEXT FOR USE or mentions seeking outside help for obtaining resources for students/classroom.</td>
</tr>
<tr>
<td><strong>Features:</strong></td>
<td>It may be a technology, human, or non-technology resource. It may also include references to raising money, fundraising, or money for resources.</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td>Technology resource that is brand specific: keynote, ipads; Technology resources that is non-brand specific: interactive white board; Non-technology resource: dry-erase markers, graph paper, textbooks, printed material; Resources that are human refer to a person who comes into the classroom to either help facilitate the class or presents to the class.</td>
</tr>
<tr>
<td><strong>Rule(s):</strong></td>
<td>This is NOT technology integration (resource in context).</td>
</tr>
<tr>
<td><strong>Routine</strong></td>
<td>Routines refer to sequential segments of socially scripted behavior such as such as checking homework, presenting content, guiding practice, and conducting discussions (Borko &amp; Livingston, 1989; Leinhardt &amp; Greeno, 1986). Participant mentions something that regularly occurs either during teaching of a lesson or in the classroom in general.</td>
</tr>
<tr>
<td>Code</td>
<td>Information</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>School organization</strong></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Participant mentions school-related rules, procedures, policies, and roles they play within a school.</td>
</tr>
<tr>
<td>Features</td>
<td>Refers to scheduling, requirements about lesson plans and planning, support personnel for technology or in class.</td>
</tr>
<tr>
<td>Indicators</td>
<td>Words such as: unit plans, weekly plans, teaching other teachers in the school – in the context that the teachers rely on this person for tech help.</td>
</tr>
<tr>
<td>Rule(s)</td>
<td>THIS MAY BECOME SCHOOL CULTURE. This is different that references to time (for teaching) and time management but does include references to common planning time and meetings for common planning. This code is intentionally broad and will be refined in a later analysis process.</td>
</tr>
<tr>
<td><strong>Student experience</strong></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Participant mentions what the students experienced during a lesson. Participant provides background information about the students, student stories, mentions students working together without direction of the teacher, students explore the possibilities of a technology resource.</td>
</tr>
<tr>
<td>Features</td>
<td>Student motions: crying, excitement, panic. Talking about student products other than assessment and student engagement.</td>
</tr>
<tr>
<td>Indicators</td>
<td>Mentions the word “we” when describe a lesson – describes the lesson in terms of a shared experience – including the students or considering the student experience and goes through it with the student. The words: engagement.</td>
</tr>
<tr>
<td>Rule(s)</td>
<td>This is different from describing a lesson or talking about a teaching strategy. This is also not assessment.</td>
</tr>
<tr>
<td><strong>Teachers teaching teachers</strong></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Participant mentions teaching other teachers or sharing knowledge with other teachers.</td>
</tr>
<tr>
<td>Features</td>
<td>Conducts workshops, emails resources.</td>
</tr>
<tr>
<td>Indicators</td>
<td>Sharing ideas.</td>
</tr>
<tr>
<td>Rule(s)</td>
<td>This is not to be confused with professional development - this is not participant learning. Refers to other teachers – counting on the participant to assist OR the participant is compelled to assist other teachers or share their knowledge within their school, time allotted for class.</td>
</tr>
<tr>
<td><strong>Teaching strategy</strong></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Participant mentions a technique used for teaching students.</td>
</tr>
<tr>
<td>Features</td>
<td>Catering to learning styles of students, additional teaching methods to reach</td>
</tr>
<tr>
<td>Code</td>
<td>Information</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Struggling students, small groups, etc.</td>
<td>Struggling students, small groups, etc.</td>
</tr>
<tr>
<td>Indicators:</td>
<td>Groups, modeling, scaffolding…</td>
</tr>
<tr>
<td>Rule(s):</td>
<td>This is a broad category of strategies that teacher use to teach students. It will have several subcategories.</td>
</tr>
</tbody>
</table>

### Technology integration

**Description:** Technology integration requires: “an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students’ prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (Koehler & Mishra, 2009, p. 66).”

**Features:** Mentions technology and benefit for students, using technology but teaching content area – less of a tech teacher, using tech to do something couldn’t do otherwise.

**Indicators:** Using technology specific to content

**Rule(s):** THIS IS A TEACHING STRATEGY – but a special one. This can be code will be refined in a later analysis process.

### Time

**Description:** Participant mentions time as a factor in teaching or provides a way to management time in a classroom.

**Features:** Any reference to time or lack of

**Indicators:** Class times, time with students, time planning, strategies to save time, using technology to save time.

**Rule(s):** Any mention of time should go in here.

### Troubleshooting

**Description:** Participant mentions solving problems related to technology OR non-technology things that can go wrong when implementing a lesson.

**Features:** Technology examples include a malfunction with the resource. A non-technology example includes time issues – running out of time or finishing early.

**Indicators:** Pilot, troubleshooting, testing out, etc.

**Rule(s):** Piloting a project is also troubleshooting. INCLUDE what can go wrong in a lesson. INCLUDE strategies for problem solving…. such as over-planning, piloting. This refers to teachers troubleshooting with technology and NOT students troubleshoot. If students are troubleshooting, code the excerpt as Student Experience.

### Unsure

**Description:** Participant mentions something that seems important but it does not fit neatly into an existing code
Table F 5
*Verb phrases according to coding frame*

<table>
<thead>
<tr>
<th>Code</th>
<th>Verb phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Provide assessments (mandated assessments)</td>
</tr>
<tr>
<td>Background</td>
<td>Provide background information</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Collaborate on lessons</td>
</tr>
<tr>
<td>Content</td>
<td>Teach content/Plan with content in mind</td>
</tr>
<tr>
<td>Display student work</td>
<td>Create an authentic audience (display student work)</td>
</tr>
<tr>
<td>Experience</td>
<td>Draw from experience</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Maintain/demonstrate flexibility</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Use existing &amp; create new knowledge</td>
</tr>
<tr>
<td>Planning process</td>
<td>Employ a planning process</td>
</tr>
<tr>
<td>Possibilities</td>
<td>Determine possibilities of/affordances for resources</td>
</tr>
<tr>
<td>Reflection</td>
<td>Reflected on past experiences – successes and failures</td>
</tr>
<tr>
<td>Resource</td>
<td>Use resources provided or acquired them</td>
</tr>
<tr>
<td>Routine</td>
<td>Establish/develop routines</td>
</tr>
<tr>
<td>School organization</td>
<td>Accept/follow school policies and procedures</td>
</tr>
<tr>
<td>Student experience</td>
<td>Regard for student experience</td>
</tr>
<tr>
<td>Teachers teaching teachers</td>
<td>Compelled to teach teachers</td>
</tr>
<tr>
<td>Teaching strategy</td>
<td>Employed a number of teaching strategies</td>
</tr>
<tr>
<td>Technology integration</td>
<td>Created technology integrated experiences</td>
</tr>
<tr>
<td>Time</td>
<td>Maximize time (instructional and non)</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>Use troubleshooting in planning and implementation</td>
</tr>
</tbody>
</table>