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THE INTERDISCIPLINARY JOURNAL OF PROBLEM-BASED LEARNING

VOICES FROM THE FIELD

Developing Clinical Reasoning Skills in Teacher Candidates Using a Problem-Based Learning Approach

Terry L. Goodin, Nancy G. Caukin, and Heather K. Dillard (Middle Tennessee State University)

Abstract

In 2013, the Educational Leadership Department at Middle Tennessee State University (MTSU) implemented a redesign of the teacher preparation program to transition from a traditional on-campus model to one delivered both on-campus and in off-campus school sites while using a problem-based learning method. This new program closely follows the medical school model of residency experiences coupled with problem-based learning events. This article describes the problem-based learning process used in this program, comparing it with the early versions of medical school problem-based learning that encouraged the development of “clinical reasoning” skills. Similarities and differences are highlighted, along with key components of the learning model in use at MTSU. The article presents lessons learned and next steps to be used in implementing the problem-based learning approach in a teacher preparation setting.

Keywords: problem-based learning, teacher preparation, professional learning communities, community partnerships, clinical reasoning skills

Introduction

The College of Education at Middle Tennessee State University (MTSU), along with the other five member universities of the Tennessee Board of Regents (TBR), implemented a teacher preparation program redesign in the fall of 2013. The old program was focused upon “class-based” learning, and the desire was to create a more “field-based” experience. Using the medical school model of problem-based learning (PBL), the new program, named *Ready2Teach*, set aside assumptions underlying traditional teacher preparation and redefined the experiences that teacher candidates need to succeed. In order to connect theory to practice, program designers consulted current research and local educators regarding practical concerns. These practitioners suggested potential problem scenarios for use in the curriculum. They did not identify “content knowledge” as being of primary importance in terms of what new teachers were lacking. They cited, instead, the types of experiences in the schools that only come from exposure to the classroom environment—for example, managing classrooms, identifying student

learning issues, and differentiating instruction based on student needs. For this reason, the first semester of the senior year, called Residency I, was designed as a school immersion experience that blends theory and practice. The TBR chose to implement this experience in a PBL format.

This paper presents the PBL model in use in the Residency I portion of the *Ready2Teach* program in the Educational Leadership Department of Middle Tennessee State University. This approach employs characteristics of the medical school model of “practice-based learning” as presented by Howard Barrows (1994) and of the model of problem-based learning as espoused by Bridges and Hallinger (1995). The paper includes a discussion of background, a description of practice, interpretations, and next steps.

Background

In 2006 the Tennessee Board of Education, in concert with 11 other stakeholder groups, formed the Teacher Quality Initiative (TQI) consortium/counsel. The TQI consortium formed a Task Force representing all stakeholder groups. The job of the Task Force was to address the need for highly

qualified teachers to replace those that were retiring or leaving the profession. For 18 months the Task Force and a set of stakeholder implementation teams worked to identify the skills and knowledge that Tennessee teachers need to master, with a focus on competencies rather than on credentials.

The Tennessee Board of Regents (TBR), which governed the six state universities in Tennessee, responded to the TQI findings with the development of *Ready2Teach*, a program that uses a residency model of teacher preparation and features a PBL methodology. University Task Forces from the six TBR universities worked together to plan the implementation. TBR committees, composed of representatives from each school, tackled problems related to technology, research, assessment, and PBL development. Middle Tennessee State University participated in every phase of the process, and especially with the design of the curriculum using the PBL format. The TBR created a PBL Core Writing Team, members of which visited a medical school to view and observe the PBL process in action at that school. MTSU then took a lead role in the design of the PBL model adopted by the TBR for the *Ready2Teach* program (Goodin, Hill-Clarke, Alberg, & Roberson, 2010). Since that time, MTSU has remained true to the PBL model as described here.

Clinical Reasoning Process

The teacher preparation program redesign at MTSU depends upon the growth of the teacher candidate's ability to develop what we call "teacher clinical reasoning" skills, a type of thinking and problem solving that closely resembles actual teacher practice. Again, we looked to the field of medicine for examples of how this works.

Howard Barrows (1994), in his discussion of the physician's "clinical reasoning" process, laid down a foundation that compares well with the *Ready2Teach* Residency I program at MTSU. Expert physicians, when faced with a patient's problem, quickly move into a sort of "shortcut" hypothesis generation phase of their problem-solving activity unless the problem is "unfamiliar, difficult or complex" (Barrows, 1994, p. 12). This is because they have faced so many similar problems in their practice that they no longer feel the need to consider all possible explanations. In fact, most problems will fall into a range of the predictable. If not, then the expert will reverse course, widen the net of possible hypotheses, and begin again. Practicing physicians will use something called the "hypothetico-deductive" reasoning process, as described by Barrows, which is composed of six steps: (1) Generation of Multiple Hypotheses, (2) Inquiry Strategy, (3) Data Analysis, (4) Data Synthesis, (5) Diagnostic and Treatment Decisions, and (6) Metacognitive Skills (Barrows, 1994, pp. 13–19). Similarly, practicing teachers have "seen it all," as it were. For example, they will know very quickly whether a

student's learning problems are caused by social considerations or a learning disability. They just seem to "know" what is the problem. However, there are cases when even they are stumped. When faced with a student issue that is outside of the expected parameters of teacher experience, they revert to a type of thinking that is like that of a practicing physician. We define this as "teacher clinical reasoning." We see this sort of professional practice as consisting of the following steps, which are very similar to the Barrows model: (1) Problem Identification, (2) Generation of Possible Solutions, (3) Identification of Research Areas or Topics, (4) Research Process, (5) Research Analysis and Synthesis, (6) Decisions Related to Practice, and (7) Metacognitive Reflection. As with experienced physicians, much of this process occurs almost without thinking (Barrows, 1994, p. 13). Our goal is to get our teacher candidates closer to being able to react quickly to changes and requirements in their classrooms, a process that is common to more experienced teachers. Knowing that only time and experience can truly ingrain such practices into the minds of new teachers, we elect to expose teacher candidates to the process itself, with the expectation that they will begin to practice it. In order to encourage this type of thinking, we carefully design PBL activities so as to allow for a robust exploration of possible solutions, targeted research strategies, sharing of ideas, and reflection. The answers to the problems are not embedded in the problem narratives; rather, teacher candidates are expected to engage in "productive struggle," with the goal of developing the types of "teacher" thinking skills that they will need in actual practice. To find answers, they must research, conduct interviews, and make observations in the field.

Description of Practice

Curriculum Design

The Eight Elements. It's important to note that the PBL model in use by the *Ready2Teach* Residency I program at MTSU is built around the Eight Elements of PBL as identified by Bridges and Hallinger (1995). These elements include: (1) Introduction, (2) Problem Scenario, (3) Learning Objectives, (4) Guiding Questions, (5) Resources, (6) Products, (7) Assessments, and (8) Time Constraints. Taken together, these elements and the associated implementation tools, which we describe below, comprise what we refer to as a PBL Event. We use the term "event" so as to encompass the totality of the PBL experience, whereas the medical school model often uses the term "module" (Barrows, 1994). We would stipulate that the "event" is composed of the written PBL, the "module" if you will, plus the field experiences, research, and the back story. Early on, the TBR adopted a curriculum model that included these essential components (Goodin et al., 2010).

The PBL Event is supported by a Facilitator's Guide that contains the fully developed Eight Elements. Each Event is situated within the context of actual practice (Brown, Collins, & Duguid, 1989). For example, one PBL Event, entitled "Alone in a Crowd," presents a first-year teacher with a dilemma while introducing the concept of professional learning communities (PLCs). A brief introduction to the Event is found in the Facilitator Notes, as follows:

First-year teacher Rachael Green is in her first week of class at Pico Alto Middle School. Even though she has "butterflies" in her stomach, she can't think of anything that she has left undone. Her room is ready, she has prepared her first unit's overall plan, and she has her whole first week's worth of lesson plans ready. She is as prepared as she can be, but at the last minute, as she is reviewing her plans for the day, she realizes that Mr. Oak, her principal, had said something about Professional Learning Communities, or PLCs. Still confident, because she remembers the term from one of her teacher prep courses, she decides to Google the term over breakfast. To her shock, she gets over 40,000 hits! She knows that she can't possibly research the concept fully, so she decides to "wing it." The result is naturally overwhelming to a new teacher just coming into a situation where everyone seems to know what's going on except her. Should she ask questions, and risk coming off as unprepared? Or will her ignorance be on display to veteran teachers who will decide that she is just another unprepared college graduate? What should she do?

PBL teams are exposed to the scenario in three vignettes, or scenes. What follows here is a copy of the problem as presented in the three scenes. After each scene, the PBL Team pauses and discusses the situation, using the PBL Learning Grid to organize their thoughts. A description of how to use the Learning Grid follows the presentation of the three scenes.

Alone in a Crowd

Scene 1

It was Thursday morning in the first week of school and Rachael was feeling a bit nervous. Today she was scheduled to participate in her first PLC meeting. Ever since she first heard the term during her interview with Principal Oak, she had meant to do some research on professional learning communities. Being so busy with beginning of the year preparations, she had neglected to do so. She Googled professional learning communities as she ate breakfast that morning and was shocked to find over 40,000 sites. Not sure where to begin, she focused

on a site that claimed to know all things about PLCs—allthingsPLC.info. She recalled the saying "How do you eat an elephant? One bite at a time," and began poring over the information as she finished her breakfast.

When the bell rang for second period to end, Rachael quickly grabbed a few things from her desk before walking to Mr. Jacobs's classroom. Mr. Jacobs was her department chair. She had downloaded a few documents onto her iPad and felt a bit more prepared for the meeting. She also grabbed a notepad and a pen and the binder issued to her by Mr. Oak on the first day.

Mr. Jacobs was a really nice man who reminded Rachael of her dad. She couldn't help but smile when he welcomed her to his room. She tried to hide the fact that she was nervous as they made small talk at the door. As other teachers began filing into the room, she followed their lead and grabbed a desk to pull into the circle they were forming. Mr. Jacobs welcomed everyone and brought the meeting to order.

As the meeting got underway, a phrase from her morning Web search stood out—SMART goals. She pulled up that document. "As you all know we always begin our year by writing our SMART goals for the year," Mr. Jacobs stated. "So let's take a look at our current reality." With this, most of the teachers began turning pages in their notebooks to some type of spreadsheet. Although Rachael did not know what this was, she began thumbing through her pages as well.

Ms. Pine spoke up first. "According to last year's TVAAS data the majority of our students scored very well," she stated. "Yes, that seems to be true," Mr. Jacobs replied, "but do we notice any subgroups that appeared to struggle?" As they discussed, Rachael began to tune out the conversation and tried to decipher the data on the spreadsheet. She wasn't exactly sure what each of the columns and rows represented.

Her attention was brought back into focus as she heard the clicking of fingers on the keyboards around her. Several of the teachers were typing something into their laptops or iPads. Ms. Pine motioned to her, stating, "Here, look on with me. This website will be new for you." Ms. Pine navigated through several drop-down menus and finally stopped on a page that looked totally foreign to Rachael. Ms. Pine said, "I am trying to pull up a report on the various subgroups in our school, so that we can look at their data separately from the other students."

With a few additional clicks, Ms. Pine's screen showed another spreadsheet that looked similar in style to the spreadsheet in her folder. With that, the group discussion went back to the SMART goals. Mr. Glenn stated, "It seems to me that our current reality is that ELL students are struggling." The other members of the group agreed with his statement and Mr. Jacobs recorded their statements on his laptop. "I do not understand why students who are still in the preproduction stage of language acquisition would even be asked to take these tests in the first place!" Mr. Glenn snapped.

"Another group of struggling students appears to be our SPED population," stated Ms. Brown. "It is hard enough when they struggle with reading comprehension, but I do not even know where to begin when they do not have phonemic awareness," Mr. Glenn stated.

(Pause here for discussion using the PBL Learning Grid.)

Scene 2

Rachael had been so involved in the discussion that she did not notice how Mr. Jacobs seemed to be keeping minutes of the meeting. She hoped he was not recording the fact that she had just sat back and said nothing of value during the entire meeting. Finally he said, "Here is what I have recorded as our SMART goal for the year." He went on to read the statement and asked the group if they agreed. Rachael's jaw almost dropped as she realized how eloquently he had stated in two simple sentences what they had been discussing for the past half hour. Mr. Jacobs printed a copy of the document and sent it around the room for the group to sign. Ms. Pine offered to make copies for everyone and stated that she would place them in each teacher's mailbox before the end of the day.

Mr. Jacobs then handed a packet of information to each of the group members to add to their binder. Rachael perused the pages and saw information about the Three Big Ideas of a PLC, establishing norms, and the Four Essential Questions. She recognized the title, "A Big Picture Look at Professional Learning Communities," from her Web search at breakfast. "We should have started the meeting with this, but I wanted to make sure we had enough time to discuss our SMART goal," Mr. Jacobs said. "Mr. Oak asked me to give you all a copy of these documents," he continued. "Since we have so many new faculty members this year, Mr. Oak wants to have a bit more training on PLCs. He has asked that we

all read over these sheets. He is looking for volunteers to lead some of the professional development workshops on PLCs. And he wants each of us, even veteran teachers, to consider signing up for one or two of the workshops for in-service hours." With that, the meeting was adjourned. As everyone moved their desks back to the place where they originally sat, Ms. Pine said to Rachael, "There is a lot to learn these days as a teacher. My door is open anytime if you need anything."

Walking back to her classroom, she overheard a conversation between two of the older faculty members from her PLC group. Rachael was surprised as one stated, "Well that was a complete waste of my planning period!" At that moment the bell rang and she quickly picked up her pace to get back to her classroom. Rachael did not have time to stop and analyze the meeting or their conversation; she was too busy trying to beat the students to the classroom as she realized that her projector was turned off and the bell work assignment was not waiting for the students.

(Pause here for discussion using the PBL Learning Grid.)

Scene 3

Six weeks had passed since Rachael's first PLC meeting. Today she was to meet her friend and fellow teacher, Cliff, for lunch before her PLC meeting. Rachael was excited for the opportunity to eat lunch off campus like "normal people" do. She had made plans to meet Cliff at her car after the dismissal bell at 11:00 a.m. It was strange how little she saw her friend now, even though they taught in the same building. At their graduation ceremony in May both were excited to tell the other about the postings they saw at Pico Alto. Once they were hired, they had helped each other to set up their classrooms. However, after the first week's meetings they hardly ever saw each other. The other wing of the building seemed like a time zone away to Rachael.

As Cliff walked toward the car, Rachael noticed that he seemed to be bothered by something. He still wore a pleasant look as he waved good-bye to students getting on the bus, but his smile stopped short of his eyes. Rachael was glad they would have time to enjoy lunch and talk before they had to be at their 1:00 p.m. PLC meetings. She hoped that a real duty-free lunch might help him to feel better.

As Rachael drove to their favorite restaurant she asked, "Aren't you excited to have the rest of the afternoon to

work in your PLC?” “No, not at all,” Cliff replied. “I’d rather have a root canal!” Nearly forgetting to stop at the red light, Rachael responded in shock, “Why would you say that? What is bothering you?” Cliff responded, “Listen, I don’t want to ruin our lunch, but if I don’t say this to someone I can trust, I may explode on someone else.”

They approached the restaurant. Pulling into the first parking spot she could find, Rachael assured Cliff that she would not tell anyone what he said. He began, “I am just so frustrated with my PLC group, well, really just Mrs. Tankersley. I know I am a new teacher. I know I have a lot more to learn, but I have a teaching degree in my subject area. I have a license to teach and my contributions are valuable too. I am so sick of being treated like a student teacher!”

Rachael was surprised by Cliff’s words. “I am not following you here. How can anyone make you feel like a student teacher? It is your name on the door and you are the one in charge of the students in your class.” He rolled his eyes. “Every time we have a meeting, she completely dictates everything we do. No one can express their ideas for lesson plans. Instead, she tells us what we are going to teach. That would be nice if her ideas were based on best practices for the students, but they are so outdated. She has such a fixed mindset that completely contradicts my growth mindset.” Trying to lighten the mood, Rachael replied, “Maybe you should invite Carol Dweck to your meetings.” “That’s a great idea. Maybe I can get Rick DuFour and Bob Eaker to come in as well,” Cliff laughed. “They could handle Mrs. Tankersley.”

The conversation continued along the same lines throughout lunch. Rachael was shocked by the stories that Cliff told of arguments between his colleagues and being belittled in the meetings. “The truth is, I don’t know how much longer I can stand to work like this,” he mused. “I never thought I would contribute to the 50% attrition rate, but I was not prepared for this at all. You expect to have to manage a classroom, not the adults you work with. The truth is I have been looking at the website for job openings.” “Oh my goodness, Cliff. Why didn’t you tell me things have gotten so bad?” Rachael asked. She thought of what Ms. Pine might say and asked, “Have you spoken with anyone about this? Who is your mentor?” Cliff snorted, “It is Mrs. Tankersley! If it wasn’t for my EA that comes during sixth period, I would feel so lonely every day. Thank goodness for Betty—too bad I can’t work with her today.”

(Pause here for discussion using the PBL Learning Grid.)

The Learning Grid. The Learning Grid, as adapted from the medical school model (Barrows, 1994, p. 56-1; Goodin et al., 2010), provides a format with space to identify Key Points, Information Needed, Learning Tasks, and Analysis and Solutions. The form seeks to clearly display “what we know,” “what we need to know,” and “where we will go for that information” (see Table 1, next page). It also gives a space for possible solutions (hypotheses) and spots for candidates to select topics and commit themselves to research in those areas. Here’s how it works. After each of the above scenes, teacher candidates work through the Learning Grid. Teacher candidates begin with the Key Points (facts, or “what we know”) after each scene, and work their way through the first two columns from left to right, with the option of dropping down into the Analysis and Solutions box at any time an inspirational thought strikes them. Each scene presents new facts and excites new conversation about what further information is needed in order to identify problems and make hypotheses. Students quickly learn how to use the Learning Grid. For example, we have observed that when someone in the group presents a bit of analysis as fact, which they sometimes do, the group will quickly catch that and will suggest putting that comment into the category of analysis or possible solutions. After the teacher candidates have worked through each scene and have filled in the Key Points and Information Needed blocks, we ask them to engage in analysis before moving on to identifying Learning Tasks. After all, it makes sense to clarify the problems that must be addressed before deciding upon the research that is necessary to inform solutions. After stating the problem, the last thing that they do is to select topics for research by using the Learning Tasks column. They also distribute the Learning Tasks among the group members. This process requires that they consolidate associated tasks, or break apart complex tasks into smaller, more manageable units that may be researched.

To continue with the example, “Alone in a Crowd,” the second scene involves all of the other teachers busily accessing a Web portal that is new to Rachael. She feels that she’s falling further behind, but is hesitant to ask for help. Her anxiety mounts. The third scene builds upon the first two, and adds important concepts such as teamwork and mentoring. Rachael’s head is fairly spinning by the end of this final scene. She knows that she has a lot to learn about PLCs, how they work, and how they don’t work, and she is also pressed to meet her instructional obligations. We intend for the PBL Team, by identifying with Rachael, to feel the anguish and distress of a new teacher who is attempting to get established in what is a new and seemingly chaotic environment.

As the PBL Team pauses after each scene and works its way through the Learning Grid, the role of the facilitator becomes important. The facilitator does not act as “information giver,”

Table 1. PBL Learning Grid. This figure shows the layout of the Learning Grid.

PBL Learning Grid		
Key Points	Information Needed	Learning Tasks
Analysis and Solutions		

but rather as a learning coach. Should teacher candidates need encouragement from the facilitator, there are Guiding Questions provided in the Facilitator Guide. Some of the questions that a facilitator may use for “Alone in a Crowd” are as follows:

- When you think of the term “Professional Learning Communities,” what comes to mind?
- Does a Professional Learning Community really have a place in schools? What do you think that would include?
- If you were to design the ideal teacher work environment, what would you include, and why?
- How would you describe adult learning as opposed to that displayed by young people?
- What role would you expect _____ to play in the PLC? (Fill in the term that teacher candidates use; for example, “communication,” “collaboration,” “accountability,” etc.)
- That’s a really good question. Where would you expect to find the answer to that? (Use this if teacher candidates approach you for information.)
- How would you be sure that the information you find is accurate and complete?

Solution Space. The use of the PBL Learning Grid provides the candidates with the opportunity to frame their thinking in an organized way, and allows the group to construct a “solution space” within which they will operate (Hmelo, 2013; Vye et al., 1997). As they identify Learning Tasks, they naturally are

forming the conceptual world that supports their research and informs their solutions. The “hypothetico-deductive” reasoning process, as applied to teachers, is on display here. Teacher candidates begin to “think like teachers” as they struggle to define problems, come up with possible solutions, and think of ways to support or refute their various hypotheses.

Learning Goals. Barrows (1994, pp. 32–34, 42) discussed the formation of learning goals both at the broad educational level and at the module level. His educational goals (paraphrased here) are to assist the physician candidate in acquiring or developing (1) an extensive knowledge base, (2) clinical reasoning skills, (3) independent, self-directed learning skills, (4) effective skills in history taking, physical examination, patient education, communication and interpersonal skills, (5) an internal motivation to learn, question, and understand, (6) an early immersion into the culture and values of medicine as a profession, and (7) an ability to work effectively in a team setting. Likewise, the *Ready2Teach* Secondary Education Residency I program has broad, overarching educational goals. Those goals are:

1. Include the edTPA (the Educative Teacher Performance Assessment) as a basis for developing strategies to maximize a secondary school student’s learning. The edTPA is a high-stakes performance assessment that our teacher candidates must take. In a sense, this is similar to medical students having to pass their

board exams and so relates to Barrows's first goal. The board exam content in medical schools, however, is sometimes treated separately from the PBL portion of the course. In our case, the content is presented concurrently with the PBLs to which it should apply.

2. Develop teacher clinical reasoning skills, such that teacher candidates are able to:
 - a. Create a classroom environment conducive to learning.
 - b. Create lesson plans that meet the needs of diverse learners including those with exceptional learning needs.
 - c. Incorporate best practices in designing instructional activities for various content areas.

This goal relates directly to Barrows's second and fourth goals, those of increasing clinical reasoning skills, and the furtherance of skills related to the profession.

3. Encourage in teacher candidates an internal motivation to take charge of their own learning, to develop themselves as scholars, and to conduct action research in their own classrooms once they have entered practice. This goal relates well to Barrows's third and fifth goals, those of self-directed learning skills and internal motivation.
4. Relate professionally within various school cultures. This goal relates directly to Barrows's sixth goal, that of immersion into the culture of the profession.
5. Participate in collegial activities designed to make the entire school a productive learning environment. This goal relates directly to Barrows's seventh goal, that of building the skills needed to be able to work together in teams.

Interpretations

Implementation of the Curriculum

Small Group Work. At the first PBL session, teacher candidates are placed into small groups, generally of six to eight people. On some occasions, because of the logistics of enrollment, we have had instructors assigned to groups of 12 candidates and we found that, not unexpectedly, these were too large to allow for effective work. We have elected to divide these large groups in half and make two separate PBL groups.

Professional Learning Communities. One significant addition to our model is the use of professional learning community (PLC) teams (DuFour, DuFour, & Eaker, 2008). The use of the term "team" is especially important in the world of PLC, as it connotes the idea of people working

collaboratively and interdependently in a culture of mutual accountability (DuFour et al., 2008). One Residency I Team member, Dr. Heather Dillard, commented, "The skills required for working as a team member are essential for 21st-century schools. Not only do teachers need to know how to assist [P-12] students in working collaboratively, they too must learn to collaborate with their colleagues. By requiring teacher candidates to work interdependently and to hold one another mutually accountable in Residency I, they will be able to immediately begin working collaboratively with their teacher teams and to instill these practices in their own students."

The concept of PLCs is at the heart of "Alone in a Crowd," and informs the background Learning Objectives for the PBL Event. We want teacher candidates to (1) identify the components of a PLC, (2) apply PLC to their own practice, (3) analyze their participation in a PLC, and (4) appreciate the role of PLCs in teacher practice. In fact, PLCs are an integral part of the natural practice of teachers in many schools. In schools, teacher PLC teams meet and work together toward the common goal of furthering student learning. There is a similarity between the PLC model of collaboration and the PBL model of thinking, in that teachers are identifying problems and forging potential solutions. The problems are usually described using data from student assessments, and teachers are focused upon what and how to teach, how to assess learning, what actions to take if students do not learn, and what to do when students have learned. One interesting feature of the PLC process is that teams are required to form a set of stated team norms, or behaviors that are expected in a professional team, and what to do if a particular teacher breaks a norm. As we developed our PBL approach, we recognized the value in duplicating this form of teaming, and we feel that the PBL groups benefit from the process.

As the idea of a PLC team is introduced to the groups in the PBL event, "Alone in a Crowd," candidates begin to recognize that they have already been working interdependently in a similar manner to PLCs and they start to identify the benefits of being mutually accountable to one another (DuFour et al., 2008). They are then required to formulate team norms and hold one another accountable to these norms for the duration of the semester. Meeting in these teams, teacher candidates work through the remaining PBL events collaboratively to inform one another of the complex issues that must be considered when developing solutions to the problems.

Participant Roles. During PBL sessions, the teams take on the traditional roles inherent in PBL grouping. The roles are rotated between candidates per PBL Event. First, there is the role of "Quarterback," or leader of the team. Another team member will perform the role of "Scribe" and will complete

the Learning Grid. Ideally, the Learning Grid is projected visually so that all members can see the notes as they are made. The Quarterback reads each scene aloud as team members follow along, and manages the discussion through the use of the PBL Learning Grid. After reading the scene they will ask, “What do we know?” and elicit the gathering of factual information as gleaned from the scene. Once all of the facts have been recorded the Quarterback will ask, “What do we need to know?” and the Learning Grid will thus be filled in from left to right. At any point in the process the team may drop down to the box labeled Analysis and Solutions and fill in thoughts that describe the problem and a possible solution.

Team Members. Each team member is a participant in the PBL problem-identification stage of the process, while the Learning Grid is being completed. At the end of the session Learning Tasks are identified, as taken from the Information Needed column, and each team member, including the Quarterback and Scribe, chooses a topic to research in a process that resembles a jigsaw method. The candidates will each produce a Research Brief, which will be shared with the rest of the team in a briefing session that will take place at a later date. The Research Brief is also used as a formative assessment by the university faculty facilitator.

Facilitator. As mentioned earlier in the description of the sessions, the role of the university faculty member is to facilitate the discussion and to “gently nudge” candidates to get them back on track if they stray too far. By and large, we have discovered that it is true that teams will generally self-correct, if we allow them enough time to do so. It is *not* the job of the facilitator to be the giver of information (Barrows, 1994, p. 52), but rather to serve in the role of metacognitive coach (Hmelo-Silver & Barrows, 2015). However, there is an appropriate use of “time for telling.” Our PBL model allows an opportunity for what is termed “just-in-time” learning that is not built upon technology, but takes place in the PBL learning group (Goodin et al., 2010). In an approach that presaged this form of just-in-time learning, Bransford, Brown, and Cocking (1999, p. 210) pointed to the practice of providing “advice when learners reached impasses in their troubleshooting attempts.” In our model, when the PBL group becomes completely stymied and further progress is threatened, then the facilitator may provide additional information that is needed for the group to become “unstuck.” Teacher candidates may need to know, for example, how to read a spreadsheet of student data. We have a short presentation on this process that can be provided when it is needed. We are very careful to speak rarely. We make the statement early in the process that “If the facilitator ever speaks, you should take this as a red

flag. They won’t interrupt the process unless you are missing something important.” If, for example, teacher candidates are making an incorrect assumption about the school’s English Language Learner (ELL) population, the facilitator may interject information about the size of the ELL population at the school in question, without giving away the consequences of having a population of that size. At the same time, the facilitators are all experienced educators, and they have the freedom to judiciously clarify certain misunderstandings that may misdirect the overall problem-solving process.

However, revealing information carries with it a risk to the process. An example of this, in “Alone in a Crowd,” would be that Carol Dweck, Bob Eaker, and Rick DuFour are all “real” people and not part of the fictitious portion of the PBL scenario. In clarifying this point, the facilitator will no doubt assure that those names make it to the list of Learning Tasks. The facilitator would then have to be sure that those names that are associated with one another, DuFour and Eaker, would have to be researched together, because they are major figures in the development of a PLC, whereas Carol Dweck is associated with the concepts of “fixed” and “growth” mindsets. So you see how delicate is the job of the facilitator. Indeed, a little information goes a long way, and sometimes leads to more and more revelation. We have learned the value of erring on the side of being quiet as opposed to being too forthcoming. In the case of the important figures just mentioned, we have learned that it is better to allow the teacher candidates to research the topics and to subsequently discover the importance of the theorists.

Our facilitators have reported that it is difficult to maintain that silence, and to take the role of “questioner” as being more important than that of “answerer.” That said, it seems that we have adapted to this new definition of our role. For example, when asked about the importance of the facilitator role in the PBL process, Dr. Nancy Caukin gave this short summary on the importance of encouraging critical thinking through questioning:

The goal is to produce Productive Struggle. We want them to identify all of the salient points possible. If they do not, then I start with broad general questions such as: What else do you notice? What else have you seen? What do you notice about how Rachael is reacting to her environment? What is she stressing over? If they mention Dweck, or one of the other key figures mentioned in the scenario, I might ask them to tell me more about that. How did you experience that? What is it that you know about them? Has anyone else ever heard about them? If they still are ready to move on, and yet have not developed much of the solution space, I might be a little more specific, asking questions such as: I wonder

what they mean when they talk about _____? What do you notice about the computers? I must always be time conscious, however. The reality is that time is limited and we must be asking ourselves how long we can afford to allow for Productive Struggle.

Likewise, Dillard observed that her teaching style had changed to the extent that she no longer sought to “bail out” struggling students, but rather pushed them to allow the process to run its course.

Heretofore, when a student indicated a need for help I quickly came to the rescue and gave them the answers, based on my own experiences in teaching. The PBL process caused me to value the opportunity for prospective teachers to engage in their own problem solving, since this is what they’ll have to do in the classroom. Additionally, I wanted teacher candidates to learn how to trust in themselves and in their peers, rather than immediately seeking guidance from an authority figure. Given the rise in the use of professional learning communities, this opportunity prepares them for the collaborative culture in today’s schools.

Facilitators take full advantage of this concept of “teamwork” as opposed to “group work.” Whereas in groups there is a problem when not all group members speak up or participate fully, in PLCs it is expected that members are to function as a “team” where each person works interdependently and where the team members are mutually accountable to one another. Caukin made the following statement:

Another key facilitator consideration is that of encouraging participation. I observe who’s talking and who’s not. If, for example, Cindy is not participating, I might ask her what she thinks about this scene. Particularly during a time when the group is floundering and Productive Struggle is lagging, I might ask Cindy to speak out. I give quiet students an opportunity to speak out. Often, they have a lot to say.

As the semester progresses, the PBL groups take on more characteristics of a PLC team. As a result, there is less need for the facilitator to use questioning techniques to coax out full participation. Dillard observed:

As part of the PLC process, team members create group norms by which they will monitor themselves when they work collaboratively. As teacher candidates become more comfortable with the PLC and PBL process, they do not allow team members to flounder. They support one another when they are struggling, they challenge one another when there’s a problem, and they celebrate one another’s successes.

Program Timeline. The Residency I goals are met through a variety of experiences occurring both in seminar class and in partnering schools. At the beginning of the semester, all teacher candidates are placed in teams of six to eight members with a faculty instructor/facilitator. Teacher candidates spend up to two days per week in field experiences in their assigned school with their team and facilitator. They then meet once per week in a three-hour seminar with two to three other Residency I teams. During the seminar, they engage in PBL Events, interact with expert guest speakers, participate in educational activities, collaborate on edTPA commentaries, share results of research briefs, and engage in in-depth discussions. See Figure 1 (next page) for an example of a timeline for a typical PBL Event.

Problem-Based Learning Events

Each PBL Event is designed to address different aspects of the program goals. See Table 2 (following pages) for a description of a program goal as aligned in a PBL Event. During the seminar, individual PLC teams engage in the PBL process. From the real-to-life scenarios, team members identify what they know, what they need to know, where they should go to find answers, and possible solutions. Each team determines which member will research individual topics to present to all Residency I teams during the next seminar class. Teacher candidates prepare formal research briefs to share with their colleagues. In the next seminar class, all PLC teams come together. Candidates from different teams but with similar topics work together to synthesize their individual research into a formal presentation, consisting of a poster of words and/or drawings. After their presentation to the entire class, these posters are displayed around the room, allowing all PLC team members to take a gallery walk through the PBL themes. Through this process, teacher candidates begin to make connections between the various PBL research topics. This process is somewhat different from the typical medical school model in which group members work solely within the confines of their PBL group. We have discovered this public defense of thinking to be beneficial to our teacher candidates, in that there is a greater exploration of the depth of the research topics under consideration.

Field Experiences

Additional connections are made when teacher candidates spend time in the partnering schools. This experience lets candidates make observations, interview staff, and relate what they researched to what they see in practice. They are placed in many different classes over the course of the semester, not just their own discipline, which allows them, through a school immersion experience, to witness the PBL scenario’s research topics from a variety of perspectives.

These field experiences are designed to be holistic in nature. During the week, teacher candidates are assigned to a local K–12,

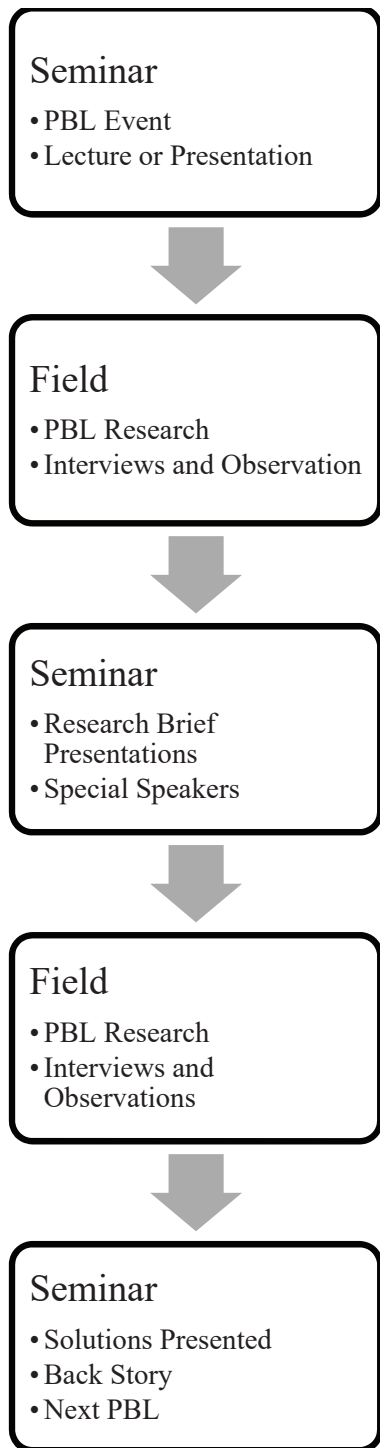


Figure 1. The typical timeline of a PBL Event. This figure shows how a PBL Event unfolds over time.

middle, or high school. Rather than being placed in one teacher’s classroom for the entire semester, the teacher candidates experience a variety of placements. Teacher candidates are assigned a mentor teacher within their major. It is with this placement that candidates are given the opportunity to work with small groups

of students and/or teach a learning segment. In addition to their mentor teacher, candidates experience a wide variety of other placements from different grade levels and subjects. Through these experiences, teacher candidates are able to witness firsthand the majority of the research topics discussed in the PBL Events. One candidate said, “It’s amazing how much you can learn from sitting in the class of a subject unlike your own and take away so many ideas to implement in your own classroom.”

Teacher candidates are given opportunities to spend time with the principal, the school resource officer, the librarian, the guidance counselor, the secretary, educational assistants, elective teachers, and core teachers who teach subjects other than the candidate’s major. The candidates participate in various school functions such as special education planning and PLC meetings as well as cafeteria duty, assemblies, pep rallies, fundraising events, and so on. Through these opportunities, teacher candidates are able to experience many aspects of the school’s culture and also to recognize the many resources available within the school. Additionally, they are challenged to find connections to their own content area as they interact in the various departments.

Finally, during the last seminar session of the PBL Event, teacher candidates engage in discussion surrounding their field experiences and interact with faculty and guest speakers who can provide expertise and a “back story” to the problems they are addressing. The “back story” answers the question of what actually happens in school settings, and ties the PBL Event to actual practice. Completing the PBL process includes candidates making their thinking and learning visible in graphical/visual representations and in written reflections. With each subsequent PBL Event, the visual representations grow to include information from all the PBL Events. This growth culminates in a final capstone poster project, which is included in the assessments portion of the program.

Assessments

Formative Assessments. Throughout the semester, teacher candidates are formatively assessed both in seminar classes and in the field. Research briefs and reflections from PBL Events provide one source of evidence of teacher candidate understanding and growth within the course. This practice is taken from the medical school model (Barrows, 1994, p. 97). Additional growth is witnessed in observation journals, discussion forums, and “I Believe” statements created by teacher candidates throughout the semester, all of which are tied to the goal of teaching teacher candidates to reflect upon their practice (goal 7 of the teacher clinical reasoning process goals).

Online discussions provide an additional formative assessment for the course. After each guest speaker, teacher candidates are required to make one substantive post in the class online discussion forum and then respond to a minimum of three other

Table 2. Program goals and PBL Events. This figure shows how a program goal is aligned with PBL Event activities.

Goals	PBL	Field Experience	edTPA	PLC	Seminar	Final Project
Incorporate best practices in designing instructional activities for various content areas.	Teacher candidates identify, research, and reflect on topics related to best practices in designing instructional activities. <i>Instructors evaluate Research Briefs for accuracy, depth of knowledge, and relevance. Reflections are analyzed for articulation of understanding.</i>	Teacher candidates observe various classrooms and demonstrate while teaching the learning segment. <i>Instructors evaluate weekly observation journals and use modified TEAM rubric to evaluate teaching, which includes a section on the teacher's knowledge of the content area.</i>	Teacher candidates demonstrate while teaching a learning segment and in the edTPA planning commentary questions. <i>Instructors use the modified TEAM rubric to evaluate teaching and the edTPA commentary rubrics to determine candidate's ability to articulate in writing.</i>	Teacher candidates discuss and share research findings related to best practices in designing instructional activities. Teacher candidates who co-teach their lessons engage in a mini-PLC with their partner to create the Learning Segment—includes instructional activities identified as best practice in their respective content areas. <i>Instructor facilitates discussions.</i>	Teacher candidates discuss and share research findings related to best practices in designing instructional activities for various content areas. <i>Instructor facilitates the discussions and models best practices.</i>	Teacher candidates create “I Believe” statements and a teaching philosophy, which includes a section on utilizing best practices to design instructional activities. <i>Instructors evaluate “I Believe” and philosophy for depth of knowledge and relevance.</i>

classmates. The expectations for dialogue within the forums are to be thoughtful, reflective, and professional as candidates discuss key points from the presentation. As in the model of practice-based learning, care must be taken to assess the interactions of the individual candidates (Barrows, 1994, p. 97).

Finally, teacher candidates are required to develop a minimum of 10 “I Believe” statements that are grounded in both theory and practice. These statements are meant to help them articulate their teaching philosophy, which not only serves as a guidepost for self-reflection but also helps to prepare them for the job interview process. As teacher candidates synthesize all the events of the semester, they are asked to formulate belief statements on

topics pertaining to the teaching process, explain why they hold this belief, and discuss how it will impact their future practice as teachers. Once refined, these statements become a portion of one of the summative assessments for the semester.

Summative Assessments. Broad educational goals are reflected in three key summative assessments for the semester: a learning segment consisting of 3–5 lessons, a group project that is a synthesis of the PLC team’s collective learning, and an individual poster that is a synthesis of personal learning. Either individual candidates or pairs of candidates, using a co-teaching model, write the learning segment, which is an opportunity for

teacher candidates to apply what they've learned from the PBL Events throughout the semester. The mentor teacher provides the standards and objectives as well as the needed resources. Both the mentor teacher and the Residency I instructor provide feedback and support for the lesson planning process. The goal is for the candidates to teach and receive feedback on their learning segment. This, then, is an expansion of our original PBL model, in that teacher candidates are able to actually engage in practice. It is similar to what Barrows (1994, p. 109) referred to as practice in the "clerkship years," wherein medical school students make the transition from being a student to being a practitioner. In our clinical field experiences, our goal is for teacher candidates to write and deliver a learning segment (a series of lessons), either in small groups or in front of the whole class of K-12 or secondary school students. Along with the writing of the learning segment, candidates engage in the edTPA, the Educative Teacher Performance Assessment, which consists of planning, instruction, and assessment activities. Their commentaries regarding these activities foster deep thinking about practices that engage all candidates in meaningful learning.

The second key assessment is a capstone team project designed to demonstrate a culmination of each team's learning for the semester. The guidelines for this assignment are left open to allow teacher candidates to demonstrate creativity with the presentation. These presentations have consisted of tangible items created and built by the team. Examples include three-dimensional representations, skits, videos, and formal presentations written and performed by the team. See Figure 2 (next page) for one example, a flower that is growing from a root of "I Believe" statements, whose petals represent all of the different topics that the PBL Team had to research in their different PBL Events.

After each team has made their presentation, teacher candidates then form a gallery of individual final capstone poster projects, which have grown from their individual graphic representations and journals. This exercise emulates an academic conference presentation and is the third key assessment. Professors and guests view the projects independently while teacher candidates present their learning for the semester. The individual posters include the candidates' "I Believe" statements, which are then used to formulate their teaching philosophy statements. Key findings from research as well as key experiences from the field are also presented on the poster. Finally, the candidate's individual graphical representation is provided along with a written description of its meaning. Once again, the parameters for the graphical representation are left open to allow for creativity. Examples of previous work have included drawings, a house of cards, a puzzle, a life vest, and many others. See Figure 3 (next page) for an example of one student's graphical representation, a teacher "toolbox."

Reactions From the Field

The teachers and principals that receive the teacher candidates for placement as student teachers have shared that these candidates are much better prepared than those in the past. Principals and district office personnel have made contact with the Residency I instructional team with a desire to hire graduates who have had Residency I. Former Residency I teacher candidates have reached out to their Residency I instructors with comments such as, "I feel that the teacher preparation program helped very much in getting me to the point I needed to begin my career" (music teacher). One former teacher candidate wrote, "Residency I really got me into the classroom and let me see firsthand what was being done and what was expected of me so that there were no surprises when I began teaching" (mathematics teacher). Another former teacher candidate wrote, "I believe I learned a great deal about the professional world through this class, especially what it is like to work in a PLC" (physical education teacher). Former teacher candidates have e-mailed to say how much they appreciate the leadership, mentorship, and support that their Residency I instructors have given them. Comments such as these serve to confirm that the Educational Leadership Department's Residency I Program is achieving initial success in meeting the demands not only of the state, regional, and national initiatives in teacher preparation reform, but, more importantly, the demands of students, school systems, and the communities that they serve.

Next Steps

After its fifth year of implementation, it is safe to say that the *Ready2Teach* Residency I Program at MTSU has had the opportunity to grow and improve. Throughout, the program has remained committed to the use of the PBL process, and we have learned much regarding the appropriate use of this method. For example, we have learned that there is such a thing as overwhelming our learners. Unlike case-based instruction, our model of PBL introduces a greater element of ambiguity. In our scenarios, we do not provide embedded "answers" to many of the questions that naturally arise from the problem as presented. Instead, we present the problem and expect the teacher candidates to identify not only the main problem but appropriate "subproblems" that need to be solved on the way to providing a solution to the overarching problem. Despite the fact that we had provided scaffolds such as the Learning Grid, resources in the field, and facilitator guidance, we determined that we were somewhat "overloading" our learners in terms of the sheer volume of work, and that they were losing momentum in the process. For example, in the first iteration of the program, we introduced a new PBL Event every two

Table 3. PBL Learning Grid in use. This figure shows the Learning Grid in the PBL design process.

PBL Learning Grid—Alone in a Crowd		
Key Points	Information Needed	Learning Tasks
<p style="text-align: center;">Scene 1</p> <p>1st week of school Rachael does not know about PLC Website allthingsPLC.info Meet 3rd Period in Jacobs’s room, the team leader Making SMART goals Using TVAAS data Looking at subgroups ELL students struggling SPED students struggling</p> <p style="text-align: center;">Scene 2</p> <p>Finished SMART goals Received a packet—3 big ideas, norms, 4 EQs, Big picture look Mr. Oak requiring training on PLCs and looking for ppl to lead PD 2 older members complain about PLC meeting Glimpse of student sitting in coach’s lap</p> <p style="text-align: center;">Scene 3</p> <p>Six weeks later Half day for students, PLC meeting today, teachers get to eat lunch out Rachael eating with Cliff Graduated with Cliff They helped each other set up rooms at beginning of year Cliff is upset with 1 member of his PLC group Cliff feels like a student teacher Ms. Tankersley dictates meetings, has a fixed mindset, outdated teaching methods Cliff looking at job openings Cliff has a growth mindset Ms. Tankersley is his mentor</p>	<p style="text-align: center;">Scene 1</p> <p>What is a PLC? Is this website legitimate? How do you become a team leader? What are SMART goals? What is TVAAS data? What are subgroups? What are stages of language acquisition? What is phonemic awareness?</p> <p style="text-align: center;">Scene 2</p> <p>What are these documents in the packet of info? What type of training is available on PLCs? Various questions on PD How do teachers feel about PLC meetings? What do you do if you see something inappropriate between a teacher and student?</p> <p style="text-align: center;">Scene 3</p> <p>Why hasn’t Rachael seen Cliff much in 6 weeks? What is going on in Cliff’s PLC? What do you do if PLC members treat you badly? What is a growth mindset vs. fixed mindset? What is the 50% attrition? How do you change jobs? Various mentor questions What do you do if your mentor is not supportive?</p>	<p>Could be various tasks including but not limited to the following:</p> <p>PLCs—various perspectives SMART Goals TVAAS and subgroups Stages of language acquisition Reading comp & phonemic awareness Professional development Inappropriate teacher/student behaviors and how to handle Growth vs. Fixed mindset Attrition issues Changing or obtaining jobs Mentors How to deal with difficult people</p>
<p>Analysis and Solutions</p> <p>Rachael will learn to seek help from a mentor teacher, establish a plan of action with her mentor, and actively participate in her PLC. She will learn how to use student data to inform her instructional planning and how to prioritize her tasks using a task management system, e.g., Franklin Planner system.</p>		

Terry Goodin observed, “We have a good idea of what we want the Solution Space to look like when our teacher candidates have completed it. Why not create that as a way of writing a PBL?” We know, for example, which overall Learning Tasks we expect to have for the PBL. We list those in the far right column of the Learning Grid. We then back up and begin listing items in the Information Needed column, in order to show what Goodin refers to as “clue phrases,” or items that we hope the candidates will identify during their use of the Learning Grid. We then back up some more in the Learning Grid and identify the facts that must be present in the PBL Scenario in order to generate the “clue phrases.” From there, we can more easily write the Problem Scenario that contains all of the facts and clue phrases needed to generate the Learning Tasks. It is through this process that we begin to construct the Solution Space that we hope will emerge during the course of the opening PBL session. We don’t expect to cover everything, and indeed we are hopeful that our teacher candidates will surprise us with new insights into the problem. As Caukin says, “It is amazing how utilizing this backwards design process allows the story to develop in a natural and organic way; it is like the PBL is hidden and it unveils itself as we engage in this process.”

We have grown as facilitators, as well, and have learned more about the role of the university faculty member. In the future, we plan to have facilitators participate in deeper PBL training so that they can become more adept at the delicate task of metacognitive coaching. We are paying particular attention to the types of questions that we ask during the PBL sessions. First of all, we point out to the teacher candidates that we will not be giving answers. Instead, our standard response has become, “That’s a good question. Where do you think we could find an answer?” Again, this is similar to the medical school model, where the facilitator would often observe that the group had discovered another learning task (Barrows, 1994, p. 62).

Because we also accompany our candidates into the field, we have learned to maximize our time with them, and we have begun to conduct some of our PBL meetings in situ. This is a relatively new addition to our program, and we anticipate that it will add a sense of increased realism to the process, in that our PBL Event sessions will be immersed in the school environment. We expect it to be similar to holding medical school PBL sessions in a hospital conference room. Initial reactions to this innovation are inconclusive, however. Our instructors generally favor the idea, for the reasons mentioned here. In a statement that typifies the reaction of the Residency I Team, one facilitator notes,

The integration of field experiences and the PBL activities has really helped the teacher candidates to think critically

about problems and issues in education. They often pose questions after a PBL Event experience. As the facilitator, I probe the candidates with questions to help direct them to the source they need to answer their questions. They will often choose to seek answers through mentors or other influential people they observe in the field. At the end of each day in the field, we reflect on observations and experiences from the day. Teacher candidates will often correlate what they identify as a key term from the PBL Event to actual occurrences in the field.

Our teacher candidates’ initial reactions, on the other hand, are mixed. One said, “I feel the group meetings are more effective in the field. When we meet in the schools all the information and experiences are fresh in our minds. The smaller groups benefit [from] the experience because with fewer people it becomes easy to share and not so stressful.” Another remarked, “Group meetings are more effective in the field because it is more relaxed. I also like that it is led more by students than teachers. I also like it because we get to share funny stories and experiences about our day.” Those comments are balanced, however, by others such as those from one candidate, who said, “I prefer to do the PBLs in the classroom. I enjoy getting with my group, appointing a leader, reading through together, and following the steps accordingly. It is also nice to know what everyone has to say and picking out topics to research. I, personally, like the orderly fashion of it in class because I am a smidge OCD.” Another candidate remarked, “I prefer doing them in the classroom rather than the field. It feels more professional. Doing them in the classroom also leaves more time for PLCs to discuss what we are seeing in the [school] classroom.” So, the jury is still “out” on this innovative approach. We will report more on this aspect of our program as we go forward.

Our increased presence in the field also raises the possibility of finding new ways to gather material for the refreshed PBL Events. In the future, we plan to take an “emic” approach to PBL Event development by observing problems and issues as they arise in the schools themselves, interviewing teachers and principals for insights into what new teachers really need to know, and perhaps by following some of our graduates into the field during their first years of teaching in order to discover what they encounter in their early experiences. To that end, we have created a private Facebook page for our graduates to use to share their experiences, both good and bad. As we progress, we hope to use this site for mentoring and for the accumulation of understanding regarding what our curriculum should contain.

Since the PBL approach is quite different from traditional teaching methods, it requires a shift of mindset and a commitment to practices that may be foreign to both the

professor and to the teacher candidate. Incorporating this methodology takes dedication to PBL principles, patience with self and learners, perseverance, and faith in the learning process. Our experience at Middle Tennessee State University has convinced us that the PBL approach, while challenging for both instructors and teacher candidates, is a more engaging, meaningful, and real-to-life way to learn and can be implemented in a teacher preparation program to build teacher clinical reasoning skills.

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