Investigations in Mathematics Learning

Spring Edition 2015, Volume 7, Number 3

Authentic Teaching Experiences in Secondary Mathematics Methods

Paula R. Stickles
Millikin University
pstickles@millikin.edu

Abstract

Often secondary mathematics methods courses include classroom peer teaching, but many pre-service teachers find it challenging to teach their classmate peers as there are no discipline issues and little mathematical discourse as the "students" know the content. We will share a recent change in our methods course where pre-service teachers teach in developmental mathematics classes, videotape lessons, and analyze and reflect on the experience.

Keywords: pre-service, mathematics methods, authentic teaching, reflection

As the modern classroom continues to evolve and students change, teacher preparation programs must continually work to meet the ever changing demands in the classroom. How can teacher candidates be best prepared to meet all the expectations of content knowledge, classroom management, assessment, pedagogical content knowledge, and the list goes on? One of the ways to assist the teacher candidates in their preparation for the classroom they will be in is to make their preparation as realistic as possible. Thus, the need for authentic teaching experiences arises. One of the most often heard complaints from teacher candidates is that what they learn in classes does not translate directly to what they will experience in a classroom. As a result, we decided it was time for a change in the secondary mathematics methods course.

The training that teacher candidates receive throughout their education plays a significant role in the type of teachers they will become (Kennedy, 1999). Teacher candidates already have a preconceived notion of what it means to be a teacher as they have observed teachers from the student side for at least the previous twelve years. Without a meaningful university ex-

perience that integrates the theory of education and the practice in the field, teacher candidates will simply revert to teaching the way they were taught (Darling-Hammond & Snyder, 2000; Kennedy, 1999; McMillan, 1985) as they struggle with putting into practice their pedagogical and content knowledge they learn in their classes (Darling-Hammond & Snyder, 2000).

Despite the contributions of the research, there is still much more to learn about preparing teacher candidates for success. For many teacher candidates, since they have observed teaching for years they believe they are knowledgeable and ready for a classroom. However, many have never had to prepare a 45 minute lesson from start to finish while clearly stating the purpose of the lesson and then been responsible for implementing the lesson as well as answering student questions and handling any classroom management issues that may arise. That leaves some teacher candidates floundering around the internet looking for an answer to no avail. The study described in this report is a first step towards restructuring a secondary mathematics methods course so that teacher candidates experience authentic classroom situations to better prepare them for what they will experience as a teacher. The general purpose of the study was to create authentic teaching experiences in a secondary mathematics methods courseso that teacher candidates could gain a more realistic experience to demonstrate their pedagogical content knowledge. Specifically, we ascertained the teacher candidates' confidence level in an array of areas. An understanding of the areas that teacher candidates are confident or lacking in is crucial due to the role that confidence and self-efficacy play in teaching effectiveness (Pendergast, Garvis, S. & Keogh, 2011; Smith & Strahan, 2004). The study had four main goals: (1) to identify the teacher candidates' confidence levels across a variety of teaching-related activities; (2) to create an authentic teaching experience to better prepare teacher candidates for their student teaching field experience and ultimately their teaching positions; (3) utilize videotaping so teacher candidates could review and reflect upon their authentic teaching experiences; (4) to determine if the teacher candidates' confidence level changed after the authentic teaching experiences; and one minor goal: to determine if there was an impact on the teacher candidates' student teaching experience.

Relevant Literature

Since Bandura's (1977) work on self-efficacy first appeared, teacher educators and researchers alike have tried to understand the role of self-efficacy in the life of a classroom teacher. As teachers' self-efficacy can greatly impact their daily beliefs in being able to succeed with their students (Bandura, 1997), it is important to understand teacher candidates' areas of confidence and concern.

Smith and Strahan (2004) completed a descriptive case study with three expert teachers and found that expert teachers have six central tendencies. One of the central tendencies is "confidence in themselves and their profession" (p. 365). The teachers in the study were confident in themselves and their ability to be effective teachers as well as a high level of personal and professional efficacy.

Darling-Hammond and Snyder (2000) considered a number of teacher education programs and their authentic assessment components in their preparation of pre-service teachers. Darling-Hammond and Snyder's definition of authentic assessment includes "opportunities for developing and examining teachers' thinking and action in situations that are experience based and problem oriented and that include or simulate actual acts of teaching (p. 524). Darling-Hammond and Snyder identify "exhibitions of performance" as a tool in authentic assessment that allows (pre-service) teachers to demonstrate skills and knowledge in teaching and learning contexts. Darling-Hammond and Snyder considered the work at Alverno College where pre-service teachers engage in a number of assessments that assess how well they apply their knowledge and skills in realistic settings.

Alverno's pre-service teachers are videotaped for a number of the performance-based assessments. Prior to receiving their assessment feedback, the pre-service teachers view the videotapes for self-assessment and reflection. As a result of Alverno's program where performance-based assessment is key, graduates are "both extraordinarily self-reflective and practically well-prepared for sophisticated practice in the classroom" (p. 536) (Darling-Hammond, 2000; Darling-Hammond & Snyder, 2000; Zeichner, 1999).

Background

Millikin University is a private liberal arts institution located in Decatur, Illinois. It has approximately 2300 traditional undergraduate students along with a MBA program, three graduate programs in nursing, as well as degree programs in an accelerated format for nontraditional students. The average class size is 23 students, and the typical faculty load is 12 credit hours each semester. The mathematics department has approximately 40 majors at any given time with about one-third of those being secondary mathematics education majors. We also offer tracks in actuarial science and applied mathematics.

Program Structure

The secondary mathematics education program is designed to be completed in four years. All required mathematics courses are completed in the first seven semesters with the eighth semester reserved for student teaching.

As Millikin is a small institution, not all mathematics students experience their classes in the same (class) year as a number of upper level courses are only offered every other year. (For example, students take Abstract Algebra as a junior or senior simply depending on whether they are a junior in an odd or even calendar year.)

In the state of Illinois, all teacher candidates, regardless of content area, are required to earn 100 clinical hours in a classroom prior to student teaching. These hours are not all necessarily engaged with students and may be simple observations. Students earn 6 – 9 hours in the educational foundations course (Introduction to American Education) typically taken as a freshman. All teacher candidates at Millikin are required to complete a thirty[1] hour internship, which is taken during the freshman or sophomore year. This experience consists mostly of observation, but some teacher candidates have one-on-one interaction with students and occasionally lead a small group scenario. Teacher candidates have a required journal they maintain with specific components that accompany this internship.

The second internship teacher candidates complete is thirty-five[2] hours and is during "junior block". The junior block is taken during the spring semester of the teacher candidates' junior year, and the internship is cohorted with their General Secondary Methods and Creating Community of Learners (classroom management) courses. In the internship, the students are placed in a local school where they are paired with a teacher. They spend time observing, interact some with students based on the supervising teacher's preference, and they are required to teach two lessons that are observed by a university faculty member. The university faculty who supervise the teacher candidates are not mathematics educators. The third, and final, internship the teacher candidates complete takes place the semester prior to student teaching and is with the cooperating teacher with whom they will student teach. It consists of 20 hours[3].

The remaining crucial pedagogical piece to the teacher candidates' program is the secondary mathematics methods course. Due to the layout of the program of upper level courses only being offered every other year, students take the course either in fall of their junior or senior year. So, students either have the course prior to their junior block experience (if they are juniors) or in the semester prior to student teaching after they have had junior block (if they are seniors). The course does not have a "field" experience in which students earn hours for their state teaching license.

[1] In Fall 2011, a number of changes were made to the required internship hours. This intership now requires 40 hours, and in Fall 2012 the intership was combined with the Introduction to American Education course.
[2] This internship now requires 40 hours.
[3] This internship now requires 60 hours.

Previous Structure of Methods Course

The secondary mathematics methods course has been fairly traditional in the sense that the standards (National Council of Teachers of Mathematics (NCTM), state standards, and now the Common Core) are discussed at length. The teacher candidates learn about the scope and sequence of a course and develop lesson plans. Case Studies are analyzed and thorough class discussions are centered on them. Teacher candidates "teach" multiple mini-lessons with varying goals/foci culminating in one full-length lesson where they have the entire class period to teach a lesson from the 8 – 12 curriculum. The lesson is videotaped, and the teacher candidates write a reflection after watching the videotape and receiving anonymous written feedback from their classmates.

However, the teacher candidates often have trouble taking on the role of the teacher. The teacher candidates find teaching to their classmates challenging because of the artificial setting. Their classmates already know the content, they are on their best behavior, and the typical questions or pitfalls that would arise in an authentic classroom situation do not take place. In the methods class, the students are also on their best behavior during their classmates' lesson. This does not give the teacher candidates an opportunity to exercise their classroom management skills. As classroom management is usually one of the toughest hurdles for teacher candidates and novice teachers (Begeny & Martens, 2006; Coalition for Psychology in Schools and Education, 2006), this is an important experience for them to have where they can receive feedback.

Searching for a Teaching Locale

Leading up to Fall 2010, it was time for a change. The teacher candidates needed a more realistic experience in the secondary mathematics methods course. One of the most common complaints of teacher candidates is that what they learn in class does not directly relate to what they will experience when they teach. So, it was decided they needed a more realistic experience in addition to teaching lessons to their peers. The remaining decision was where to have the teacher candidates teach. Placing them out in the public schools would not be an easy task due to the already overwhelming demand on the schools for internships and student teaching
placements, so that was the last on the list of possibilities. So, the question was where to go?

Millikin is not unique as in recent years, over 40% of the incoming freshman class has needed at least one developmental mathematics course (Millikin University Office of Institutional Research, 2012). Research indicates that only 32% of students graduating from high school are prepared for college level course work, and this percentage is lower for minority students (Greene & Foster, 2003). As such, Millikin offers three developmen-

tal mathematics courses. One of the developmental mathematics courses is Intermediate Algebra. The content is comparable to an Algebra I course in the K–12 curriculum, which seemed an appropriate place for the teacher candidates to flex their teaching wings.

Design of the Study

Participants

The primary participants are the teacher candidates enrolled in Secondary Mathematics Methods who are typically either seniors who will be student teaching the next semester, or juniors who will student teach a year after completion of the course. The majority of the teacher candidates are secondary mathematics education majors. Additionally, elementary education majors who are earning a middle school mathematics endorsement are required to take the course. Occasionally, an applied mathematics major who is interested in teaching (perhaps as a graduate assistant) is enrolled in the course with consent of the instructor. All the teacher candidates enrolled in the course during Fall 2010 were secondary mathematics education majors.

Survey Instrument

At the beginning of the semester, in an effort to gather information about the teacher candidates' confidence levels on different areas of teaching, they were given a survey with a Likert-type scale where 1 represented strongly disagree and 5 strongly agree. The teacher candidates completed a similar survey at the end of the semester. The survey at the end of the semester had three items directly related to the authentic teaching experience as well as two open-ended questions in which the teacher candidates could expand on their selections. (The pre and post surveys are in Appendix D.)

Experience

Teaching. Each teacher candidate taught three lessons in an Intermediate Algebra class at Millikin. Lesson plans were due two days prior to teaching so that the Secondary Mathematics Methods instructor had an opportunity to offer feedback on items such as selection of examples, structure, and timing and to ensure the appropriate planning and care had been taken in preparing the lesson. The teacher candidates wrote their lesson plans using the same format and standards expected during the student teaching experience. Further, the teacher candidates met with the Secondary Mathematics Methods instructor prior to the lesson taught for feedback on their ideas during the development of the lesson.

The teacher candidates were given a seven-week window in which to complete their three lessons starting during the sixth week of the semester.

They had a schedule of the Intermediate Algebra course and what topics were to be taught when. It was up to the teacher candidates to select what topic/day they wanted. This approach was decided in an effort to reduce the argument about getting an "unwanted" topic and to select days that worked well in their schedules. (This was an attempt to avoid scheduling a teacher candidate to teach a lesson when they had multiple examinations or major projects scheduled in their other courses.)

Video reflection. In addition to having an authentic audience for teaching, a critical piece in the teacher candidates' growth is that all lessons were videotaped. The teacher candidates were required to view the video of each of their lessons in order to reflect and write a self-analysis of the lesson taught. Teacher candidates considered immediate and planned decisions they made and analyzed the reasons why they made these decisions and their effectiveness in improving student learning. They identified pedagogical strategies they used to extend student thinking (e.g., wait time, follow-up questions, withholding judgment, asking for summary, encouraging thinking aloud), what went well and what did not, and identified ways to improve. After submitting their written reflections to the methods instructor, each lesson was followed up with a meeting with the methods instructor for verbal feedback in addition to the written feedback that could be used to improve on the next lesson and to identify areas that need improving prior to the student teaching experience. The written feedback the teacher candidates received was in the same format that they will receive after each observation they have during their student teaching experience.

Final reflection. After all the teacher candidates completed their lessons in the Intermediate Algebra course, each identified a "shining moment" and one they can learn from within the lessons. These video moments were shared in the Secondary Mathematics Methods class to help each other grow from the experiences (see Appendix C).

Preparing for the Experience

In preparation for the authentic teaching experience, a number of steps had to take place. First, the teacher candidates had to prepare to constructively criticize themselves and their classmates. The first step was a class viewing of a lesson from the Inquiry Learning Forum (n.d.). The teacher candidates were able to move from simple passive statements such as "That was good" to specific observations of the use of the board and examples chosen as well as teacher mannerisms and pedagogical techniques.

To acclimate to the presence of a video camera and to prepare to watch videos of themselves, the second week of class, each student presented a mini-lesson to the class with a non-routine problem (see Appendix A). In addition to learning to seek out non-routine problems, the teacher candidates were able to work on receiving (and giving) constructive criticism

from (to) classmates. The teacher candidates also had to view the video of the lesson and write a self-analysis/reflection of their teaching integrating the feedback from their classmates.

In preparation for being able to think on their feet in front of students, often at the beginning or end of class a student was randomly selected to explain a typical mathematics problem from the 8 – 12 curriculum. The intention was for the teacher candidates to become better at explaining *how* to solve a problem as opposed to simply completing the problem. Examples of these problems may be found in Appendix B.

Finally, during weeks 2 – 4 of the semester teacher candidates wrote a lesson plan on a designated topic and received feedback after receiving instruction and discussing the vital elements of a lesson. The teacher candidates were instructed to write the lesson plans in the format that would be expected during their student teaching experience. (This is not necessarily the format they use in their General Secondary Methods course during junior block.)

Summary of Findings

Surveys

In the initial offering of the revised methods course in Fall 2010, only four teacher candidates were enrolled. Although this does not allow for the establishment of any statistical significance the results are still positive. There were questions appearing on both the pre- and post-surveys that identified areas that teacher candidates had confidence. We consider those first.

As one would hope (and expect), all questions showed an improvement. The teacher candidates' confidence in their ability to try new ideas/activities in their classroom increased from 4.0 to 4.25, and in their ability to answer students' mathematics questions increased from 3.5 to 4.0. Teacher candidates' confidence in their ability to critically analyze their teaching skills in an objective manner increased from 3.5 to 4.0. It was hoped that this increase would be greater, but it is suspected that the teacher candidates did not rate this as high as they often thought they did much better than their lesson grades indicated. The areas with the greatest increases were the teacher candidates' confidence in their ability to locate resources for teaching mathematics increased from 3.0 to 4.5, and their ability to plan daily lessons increased from 3.0 to 4.25. As the students wrote numerous lesson plans throughout the semester, it is great to see this increase, but an even greater one was hoped for. One student wrote, "I still need work planning daily lessons and not to plan too much in one day, but I am much more confident than before."

The survey at the end of the semester had three items directly related to

the authentic teaching experience as well as two open-ended questions in which the teacher candidates could expand on their selections. The items consisted of: (1) Teaching lessons in MA106 (Intermediate Algebra) increased my confidence in my ability to answer students' questions; (2) Writing reflections based on the videos of teaching in MA106 has helped my growth as a teacher; (3) Watching the videos of my lesson revealed weaknesses in my teaching of which I was unaware. All teacher candidates responded with strongly agree or agree. Table 1 contains the results from the pre and post survey.

Table 1. *Summary of Pre- and Post- Surveys*

	Pre-	Post-
I am confident in my ability to locate resources for teaching mathematics.	3.0	4.5
I am confident in my ability to critically analyze my teaching skills in an objective manner.	3.5	4.0
I am confident in my ability to plan daily lessons.	3.0	4.25
I am confident in my ability to answer students' mathematics questions.	3.5	4.0
I am confident in my ability to try new ideas/activities in my classroom.	4.0	4.25
Teaching lessons in MA106 increased my confidence in my ability to answer students' questions.	-	4.33
Writing reflections based on the videos of teaching in MA106 as helped my growth as a teacher.	-	4.67
Watching the videos of my lesson revealed weaknesses in my teaching of which I was unaware.	-	5.0

The teacher candidates indicated that the videos identified habits/mannerisms that they did not know they had. A surprising result was that the students indicated writing the reflections were beneficial. Although reflecting is a crucial component of growth, the teacher candidates are typically vocal about not wanting to reflect on what they have done. Selections of teacher candidates' comments from the survey are presented in Figure 1.

Discussion

Instructor Reaction

As was hoped, the teacher candidates acknowledged they had areas to work on of which they were unaware. As opposed to previous semesters when the teaching done was peer teaching, the students appeared to work harder and put in more preparation time knowing it was a "real" class they would be teaching. They had concerns about making sure the content was

• I think the most beneficial part was by far reflecting on our lessons after we watched them for ourselves, and seeing your comments on our lessons as well.

• I think watching the videos and writing reflections were the most beneficial parts because I learned a lot about my habits from watching myself so often. Now I have time to work on perfecting things before I get to my student teaching experience.

• One of my biggest fears was answering students' questions if I didn't know the answer but I am more confident in my ability to do that now.

• The videos really helped to point things out (board work, filer words, etc.) that I didn't really know I was struggling with.

• I really feel the most beneficial part is finding the little things I do that I don't necessarily realize I am doing while I teach.

Fig 1. *Teacher candidates' comments from the post survey.*

right as well as being able to answer student questions. This was exactly the hope. The students were experiencing authentic teaching. They were preparing just as if they had to teach in a secondary classroom.

A great amount of growth was observed in the candidates from the first problem presentation they gave in class until the last reflection on teaching presentation they made. Teaching in the authentic classroom helped the teacher candidates make great leaps. By the end of the semester, most were performing at where it is expected they would be by their first or second official visit during the student teaching experience in their final semester. The teacher candidates felt as if they had a true goal they were working towards during the semester as opposed to "just" student teaching, which seemed so far away for some. With each authentic teaching experience they received instructor feedback as to what to focus on for the next lesson. This gave the teacher candidates focus as opposed to trying to improve across the board.

Since the instructor is also the student teaching supervisor, a direct impact has been observed during student teaching. There are much less growing pains during student teaching as those have already been experienced during the methods course. Teacher candidates' midterm evaluations are much stronger than previously. The teacher candidates are much more aware of the expectations of their supervisor during student teaching because they have already experienced those throughout the secondary mathematics methods course. This had made for a much smoother student teaching experience for the teacher candidates as well as the supervisor.

Lessons Learned

The first attempt at including authentic teaching in methods was a great success but with all first attempts there were some areas needing improvement. First, allowing the teacher candidates to pick their own teaching days

and topics gave them too much freedom as they were in no hurry to make selections. They also tended to be interested in finding a "fun" topic to teach rather than simply focusing on the content.

The instructor did not watch the lessons taught live. Each lesson was recorded and viewed later. This was simply a matter of the instructor's course schedule. This was time consuming as numerous office interruptions occurred while attempting to view the videos. Additionally, the "classroom vibe" as well as the reaction of all student participants is not captured on the video. One needs to be in the classroom to experience this first hand.

For some teacher candidates, this experience was a big leap. They needed more "hand holding" to make the transition and more practice in planning the lesson and then teaching for a full fifty minutes. Most teacher candidates had never had to teach more than just a short 20 to 30 minute mini-lesson that they did not plan from start to finish. They also always had someone there to back them up whereas in the Secondary Mathematics Methods course they were told that no one would rescue them if they froze or had difficulties during the lesson. They would have to work their way through it.

Second Attempt at Restructuring

As a result of these lessons learned, each was addressed in the Fall 2012 offering of the course. Ten teacher candidates were enrolled in the course. The teacher candidates did not get to select the course or topic to be taught. The instructor made those decisions prior to the semester by looking through all of the teacher candidates' course schedules. The teacher candidates were informed on the first day of the semester what class, topic, date, and time they would be teaching their lessons.

As to watching all the lessons live, the instructor made sure to have a course schedule that would allow for teaching candidates to teach in those courses and be flexible enough to see the teacher candidates teach in colleagues' courses. All authentic lessons in Fall 2012 were viewed live by the instructor.

In Fall 2012, more time was spent writing lesson plans prior to the authentic teaching experience. Significant written feedback was given on lessons in an attempt to better prepare the teacher candidates to write their own lessons. In addition, since many of the teacher candidates had never taught more than 20 to 30 minutes, they were required to do a dry run of their lessons in front of at least two of their classmates prior to teaching it to the authentic classroom. They received written feedback from their classmates (which was submitted to the instructor for verification) on how to improve their lesson. This was one of the most commented on assignments during the semester. The teacher candidates found it to be extremely beneficial and valuable in improving their lessons. (The dry run assignment may be found in Appendix E.)

Outgrowth of Restructuring of Methods Course

As an outgrowth of this work, the senior-level mathematics course Internship in Methods of Teaching Mathematics has been restructured. (The course is required of all secondary mathematics education majors.) This course is one in which the enrolled student serves as a teaching assistant to one of the tenured or tenure-track mathematics faculty for a course. The student is required to attend class meetings, hold regular office hours, teach three lessons, and other requirements as laid out by the faculty member. The purposes of the internship are for the student to become more familiar with course management, assessment, presentation, and to grow as a tutor and teacher. With the development of the new authentic teaching experience as part of the Secondary Mathematics Methods course, parts of this experience were modified and carried over to the internship.

In the past, a student registered for the internship but depending on what faculty member he/she was assigned to the experience was vastly different. As the course is now required for all mathematics education majors, the department felt it was important to have a similar experience regardless of the course or faculty member to which the student is assigned. Since teacher candidates, in general, need more authentic teaching situations, it was determined that it was important to make the mathematics teaching internship more rigorous.

The interns all report to the intern coordinator (also the Secondary Mathematics Methods instructor) regardless of the faculty member they are assigned to. When they teach their lessons, they now videotape them and have to watch them back and reflect on what was taught and how it can be improved upon. The coordinator also analyzes the video and gives written feedback. Additionally, the interns (teacher candidates) have reading assignments, writing assignments, a final examination, and must maintain a reflective journal, all similar to what is done in Secondary Mathematics Methods. All of the items are submitted to the coordinator throughout the semester to receive feedback for improvement.

Achieving the Goals of the Study

This study had four main goals: (1) to identify the teacher candidates' confidence levels across a variety of teaching-related activities; (2) to create an authentic teaching experience to better prepare teacher candidates for their student teaching field experience and ultimately their teaching positions; (3) utilize videotaping so teacher candidates could review and reflect upon their authentic teaching experiences; (4) to determine if the teacher candidates' confidence level changed after the authentic teaching experiences; and one minor goal: to determine if there was an impact on the teacher candidates' student teaching experience.

Through the survey instruments given prior to and after the authentic

teaching experiences, we were able to not only identify the teacher candidates' confidence levels across a variety of teaching-related activities but we were also able to show an improvement in confidence levels, thus achieving goals one and four. Based on the confidence or lack thereof indicated in the pre-survey, classroom activities were integrated to help prepare the teacher candidates for the authentic classroom teaching. For example, as the teacher candidates were not overly confident in their ability to plan daily lessons, multiple opportunities were integrated into the methods course to improve upon this skill. In the post-survey the teacher candidates indicated an increase in their confidence in this area. As they had to prepare their own lessons for their authentic teaching experience, this is a great success. We expect this confidence will only continue and will help them in their effectiveness as classroom teachers (Pendergast, Garvis, S. & Keogh, 2011; Smith & Strahan, 2004).

We were able to successfully create an authentic teaching experience to better prepare teacher candidates for their student teaching field experience and ultimately their teaching positions thus achieving goal two. We are confident the experience was successful as all responses to the post-survey regarding the authentic teaching experience were either agree or strongly agree. These experiences coincide with Darling-Hammond and Snyder's (2000) work that the "exhibitions of performance" allowed the pre-service teachers to integrate and demonstrate their content and pedagogical skills in realistic settings.

Goal three of the study to utilize videotaping so teacher candidates could review and reflect upon their authentic teaching experiences was a great success. As noted in the comments in Figure 1, the teacher candidates found that viewing and reflecting upon their videos was more beneficial than any written feedback we may have given them. The teacher candidates grew throughout the process and were able to critically analyze themselves so that they are wellprepared for what they will face in their own classrooms. This level of preparation and growth is in line with the work that came out of Alverno College's program (Darling-Hammond, 2000; Darling-Hammond & Snyder, 2000; Zeichner, 1999). Teacher candidates who are given the opportunity to demonstrate their skills through performance-based assessments and have the opportunity to self-assess and reflect are well-prepared for their future careers. The one minor goal of the study to determine if there was an impact on the teacher candidate's student teaching experience is considered a success. Although there is no hard data (except the written midterm evaluation reports) for the teacher candidates, there is anecdotal evidence. The teacher candidates are indicating that they feel more confident going into their student teaching placements. There are no longer panic stricken phone calls from teacher candidates. The teacher candidates are starting their student teaching placements performing at a level that previ-

ously had not been seen until at least midway through the student teaching experience. The midterm evaluation written reports from the student teachers' cooperating teachers are coming in with higher ratings than prior to the implementation of the authentic teaching experiences, and final course grades in student teaching have gone up. All signs are pointing to better performances in the student teaching experiences.

Conclusion

The opportunity to give teacher candidates an authentic teaching situation cannot be ignored. The videotaping of all the lessons of the teacher candidates and their analysis of their videos helps the teacher candidates to grow as teachers through reflection. This entire process of close consulting and mentoring by the Secondary Mathematics Methods instructor, teaching to an authentic audience, reflection and analysis via videos of the lesson, as well as experiencing the same evaluation process that is used during student teaching gives the teacher candidates an invaluable experience that will better prepare them for their student teaching experience and future in the classroom. The experience enables them to expand their pedagogical techniques and classroom management skills and the video reflection encourages growth. As a result, the teacher candidates are much more confident in their ability to manage a classroom and teach the content in an effective manner.

Without this type of methods course, the mathematics teacher candidates are missing out on a valuable opportunity to teach in an authentic classroom setting where they would have the opportunity to put their newly learned theory into practice in mathematics courses. The video reflection piece is an opportunity they may never have again. When will they ever have another opportunity to teach lessons under the supervision of a mathematics educator while videotaping themselves to be able to analyze the decisions made throughout the lesson? This authentic teaching format gives them that opportunity where they can learn from the wisdom and experience of their methods instructor who will also be their university supervisor during student teaching. This experience gives the teacher candidates an incredible opportunity to grow as a teacher and to lay the foundation for a productive working relationship of supervisor and teacher candidate. Having a methods course that is closer to a true classroom experience has the potential to impact teacher candidates' success in the classroom for years to come.

References

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191 – 215.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Begeny, J. & Martens, B. (2006). Assessing pre-service teachers' training in empirically-validated behavioral instruction practices. *School Psychology Quarterly*, 21(3), 262 – 285.

Coalition for Psychology in Schools and Education. (2006). Report on the Teacher Needs Survey. Washington, D.C.: American Psychological Association, Center for Psychology in Schools and Education.

Darling-Hammond, L. (2000). *Educating Teachers*. San Francisco: Jossey Bass.

Darling-Hammond, L. & Snyder, J. (2000). *Authentic assessment of teaching in context.* Teaching and Teacher Education, 16, 523 – 545.

Greene, J. & Foster, G. (2003). *Public high school graduation and college readiness rates in the United States*. Manhattan Institute, Center for civic information, Education Working Paper, no. 3.

Inquiry Learning Forum. (n.d.). Retrieved from http://ilf.crlt.indiana.edu/.

Kennedy, M. M. (1999) The role of preservice teacher education. In L. Darling-Hammond and G. Sykes (eds). Teaching as the Learning profession: Handbook of Teaching and Policy. (pp. 54-86). San Francisco: Jossey Bass.

McMillan, C. (1985). Do teachers teach as they are taught to teach. *American Reading Forum, (5),* 85 – 87.

Millikin University Office of Institutional Research (2012). Data Request. Decatur, IL.

Pendergast, D., Garvis, S., & Keogh, J. (2011). Pre-Service Student-Teacher Self-efficacy Beliefs: An Insight Into the Making of Teachers. *Australian Journal of Teacher Education, 36*(12), 46 – 58.

Smith, T. & Strahan, D. (2004). Toward A Prototype of Expertise in Teaching A Descriptive Case Study. *Journal of Teacher Education, 55*(4), 357 – 371.

Zeichner, K. (1999). Ability-based teacher education: Elementary teacher education at Alverno college. In L. Darling-Hammond, *Studies of excellence in teacher education: Preparation in the undergraduate years*. New York, Washington, DC: National Commission on Teaching and America's Future, American Association of Colleges for Teacher Education. Washington, DC: American Association of Colleges of Teacher Education.

Appendix A

Non-routine Problem Presentation
(25 points possible)

Each teacher candidate will present a non-routine problem appropriate for pre-algebra through pre-calculus. The problem and at least one solution method (not just the answer) should be copied for the other members of the class and your instructor for distribution at the end of the presentation. On copies for distribution please include your name, date of your presentation, type of problem and level (if applicable), how the problem might be used (opening activity, problem of the week, puzzle, etc.) and the source.

The teacher candidate will present the problem, indicating for what purpose the problem could be used and at what level, and then give the other students about 10 minutes to solve the problem. At the end of the 10 minutes, the teacher candidate should first ask if someone has solved the problem and let the student(s) who solved the problem explain his/her solution(s); explain the solution to the problem with that student's(s') help or explain the solution himself/herself.

In all cases the teacher candidate should try to involve the other students as much as possible. Grades will be based on presentation and choice of problem. Total length of presentation should be no more than 20 minutes. In order for your instructor to run off the copies for the class, the problem and at least one solution method must be submitted during the previous class; otherwise, you will need to do this.

Each presentation will be videotaped. Upon completion of the lesson, each student will view his/her session on tape and write a 1–2 page self-analysis/reflection paper. Discuss what went well and what did not go so well including specific examples; provide suggestions for improvement. Integrate the feedback from classmates. These reflections and comments should help you improve the lesson for future use.

Appendix B

Sample of Explanation Problems

1.) A surveyor stands 60 feet away from a building and sights the top of the building with a surveying device mounted on a tripod. If the surveying device is 5 feet above the ground and the angle of elevation is 50°, how tall is the building?

2.) Solve $\sqrt{x}-1=\sqrt{2x+1}$.

3.) Solve $x^2+8x+13=0$ by completing the square.

4.) Joe has 120 feet of fencing to make a rectangular dog pen. If a house is used for one side of the pen, what would be the length and width for maximum area? What would the maximum area be?

5.) Three circles of radius 3 cm, 5 cm, and 9 cm, are all tangent to one another. Find the angles, to the nearest tenth of a degree, that the lines connecting the centers of the circles make with each other.

6.) What are the solutions of $(x+1)(x-4)=6$?

7.) Write the equation of a quadratic function that passes through the point (2, –2) and has vertex (4, 1).

8.) Write the polynomial f(x) of least degree with integer coefficients that has the given zeros.

$2,\ 1-3i$

9.) Solve the following equation by factoring. $x^3=16x$

10.) Find all zeros for the function $f(x)=3x^3-2x^2-7x-2$.

11.) If $f(x)=3x^2-Bx+2$ and $f(2)=6$, what is the value of B?

12.) A balloonist flying over an island observed that the angles of depression of the north and south end of the island were 32° and 47°, respectively. Using special radar equipment he determined that his distance from the south end of the island was 2825 feet and from the north end was 3880 feet. What is the distance from the north end to the south end of the island?

13.) Form a polynomial $f(x)$ whose zeros and degree are given.

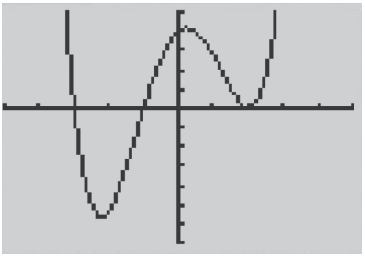
Zeros: 3 multiplicity 2, 0 multiplicity 1, -4 multiplicity 1; degree 4

14.) Find values of k so that $x+1$ is a factor of $f(x)=5x^3+k^2x^2+2kx-3$.

15.) If $\log_a 2=0.301$, $\log_a 5=0.699$, and $\log_a 6=0.778$, find the following.

(a) $\log_a 3$ *(b)* $\log_a 50$

16.) Construct a polynomial $f(x)$ that might have the given graph.



17.) Joe has $8.75 in quarters and dimes. If he has five more dimes than three times the number of quarters, how many of each coin does he have?

18.) Find a value for k so that the remainder is 3 when $(x^4 + kx^3 - 7x^2 + 8x + 25) \div (x - 1)$.

1

19.) Determine the linear equation that passes through (2,1) and (−3,5). Write your final answer in slope-intercept form.

20.) Find all the zeros of $f(x) = x^4 - 2x^3 + 6x^2 - 8x + 8$ given that $1 + i$ is a zero.

21.) Solve each of the following equations.

(a) $x\sqrt{5} - 4x\sqrt{5} = 4x - 3$ *(a)* $x\sqrt{5} - 4x\sqrt{5} = 4x - 3$ *(b)* $\sqrt{x-7} + \sqrt{x+5} = 6$

22.) Write the equation of the line passing through the point (2, 3) and perpendicular to the line $3x - 2y = 4$. Write your final answer in slope-intercept form.

23.) Solve $|2x + 5| \geq 13$.

24.) Find the multiplicative inverse for each of the following. Write each answer in complex form.

(a) $2 + i$ *(a)* $2 + i$ *(b)* $\dfrac{3+i}{1+2i}$

25.) Solve the following system using the elimination method. Tell if the system is consistent and independent, consistent and dependent, or inconsistent.

$$8x + 5y = 12$$
$$3x - 7y = -31$$

Appendix C

Reflection on Teaching Presentation

Each teacher candidate will give a presentation based on the three teaching experiences at Millikin. The presentation will highlight what went well and what did not go so well including video clips from the lessons. Any one video clip should not be more than three minutes in length. The presentation should contain at least three video clips. For the clip(s) that illustrate areas that need improvement, provide suggestions for improvement. For the clip(s) that illustrate what went well, identify why it went well.

The length of the presentation may range from 8 to 12 minutes. The videos should be edited to only show the relevant clips. (I highly recommend using Windows Movie Maker.)

My presentation is on _____.

Appendix D

PRE

Name _____

I. For each of the following, circle the indicator that most accurately represents your opinion where the indicators are as follows.

SA = strongly agree; A = agree; U = undecided; SD = strongly disagree; D = disagree

I am confident in my ability to locate resources for teaching mathematics.

SA A U D SD

I am confident in my ability to critically analyze my teaching skills in an objective manner.

SA A U D SD

I am confident in my ability to plan daily lessons.

SA A U D SD

I am confident in my ability to answer students' mathematics questions.

SA A U D SD

I am confident in my ability to try new ideas/activities in my classroom.

SA A U D SD

II. Expand on any of the above statements as appropriate.

III. As you think about your future in the mathematics classroom, what are you most concerned about?

POST

Name _____

I. For each of the following, circle the indicator that most accurately represents your opinion where the indicators are as follows.

SA = strongly agree; A = agree; U = undecided; SD = strongly disagree; D = disagree

I am confident in my ability to locate resources for teaching mathematics.

SA A U D SD

I am confident in my ability to critically analyze my teaching skills in an objective manner.

SA A U D SD

I am confident in my ability to plan daily lessons.

SA A U D SD

I am confident in my ability to answer students' mathematics questions.

SA A U D SD

I am confident in my ability to try new ideas/activities in my classroom.

SA A U D SD

II. Expand on any of the above statements as appropriate.

III. As you think about your future in the mathematics classroom, what are you most concerned about?

IV. For each of the following, circle the indicator that most accurately represents your opinion where the indicators are as follows.

SA = strongly agree; A = agree; U = undecided; SD = strongly disagree; D = disagree

Teaching lessons in MA106 increased my confidence in my ability to answer students' questions.

SA A U D SD

Writing reflections based on the videos of teaching in MA106 as helped my growth as a teacher.

SA A U D SD

Watching the videos of my lesson revealed weaknesses in my teaching of which I was unaware.

SA A U D SD

V. Expand on any of the above statements as appropriate.

VI. As you think about your experience of teaching in MA106 and the process of watching the videos of the lessons, what was the most beneficial of the experience?

Appendix E

Preparing for Teaching Lessons

As part of the preparation for the teaching of lessons in classes at Millikin, each teacher candidate will do *at least* one dry run of each lesson in front of a subgroup of her MA425 classmates. It is the teacher candidate's responsibility to select at least two members of the class to observe and constructively critique the lesson prior to teaching it in the Millikin class.

The class members who observe the dry run of the lesson are to complete a feedback form (see below) and give it to the teacher candidate. The teacher candidate should use the feedback to improve the lesson and its presentation. The teacher candidate is to submit the forms to your instructor no later than the day the lesson is taught.

Teaching Lesson Dry Run Evaluation Form

Teacher Candidate:

Lesson Topic:

Date of Dry Run:

At least Three Positives:

At least Three Constructive Criticisms:

Most Important Suggestion in Preparation for the "real" lesson:

General Comments:

Overall Rating: 1 2 3 4 5
(1-low, 5-high)

Evaluator: