Two Mathematics Teachers Talk about their Teacher Preparation Experiences: One an Undergraduate Degree and One a Masters Degree

Jan A. Yow
University of South Carolina-Columbia
College of Education, Instruction & Teacher Education
Columbia, SC 29208
(803) 777-2472
jyow@sc.edu

Abstract

An exploratory research approach is used to characterize the experience of two second year high school mathematics teachers in their teacher preparation programs: one graduated from a four-year undergraduate program while the other graduated from a fifth-year masters program. The two main forms of data collection included interviews and document review. Findings showed that both teachers felt prepared for the mathematical demands of their jobs but ill prepared for what they termed "on-the-job knowledge." Each teacher offered suggestions for improving their teacher education programs. Complete program curricula are included in the appendices.

Introduction

Teacher educators are continually searching for the best way to educate teachers (Sowder, 2007). Debates persist about what is the most promising format for teacher education: a four-year undergraduate degree? a fifth-year graduate degree? a major in the subject matter? a major in the teaching of that subject matter? (Wilson, Floden, & Ferrini-Mundy, 2002; RAND, 2003). Mathematics teacher education researchers have even compared the progress made in understanding how children learn mathematics as a model to be used in understanding how pre-service teachers learn to teach (Korthagen & Kessels, 1999).

Such research forces three research questions: *How do second year mathematics teachers reflect on their experiences in their own secondary mathematics preparation programs? Now that they are in the field, how do they remember their preparation time? What was most valuable and what would they have liked to seen added to their program?* Using an exploratory approach (Johnson & Christensen, 2000), two second year teachers (Appendix A) whom offered insight into their teacher preparation programs. Both graduated from different secondary mathematics education programs offered at two large southeastern universities separated by about 20 miles. As exploration is one of the first objectives in research (Johnson & Christensen, 2000), in addition to the interviews, document review (Appendices B & C) was also used as a data source. Mathematics teacher preparation program literature was reviewed from both

universities to better understand each program. Triangulation helped to clarify what the teachers said and how the literature reads to further clarify data interpretation (Weiss, 1994; Coffey & Atkinson, 1996; Glesne, 1999).

Bill & Donna: The teachers

Bill (Pseudonyms have been used to replace the actual names of the teachers and their respective universities.) is a white male in his early 20s who graduated from a large southeastern university with a four-year mathematics degree. He continued on for a fifth year in the university's Masters of Arts in Teaching program. He is now a second year high school mathematics teacher and varsity girls' softball coach in the same high school where he did his student teaching. He currently teaches Introduction to Mathematics for English as a Second Language students, Algebra I, and Honors Geometry. Bill had always wanted somehow to work with sports and initially had planned to become an orthopedic doctor. After entering college, he realized that as a doctor, he would see people at their worst. He knew he wanted to be in a profession that combined sports and helping people. One morning he woke up with what he calls "an epiphany" (Bill, interview) that he wanted to teach. He could teach and stay involved in sports. His advisor suggested getting a degree in the field he wished to teach and then pursuing a teaching license. Mathematics was the subject he enjoyed the most and was "good at" (Bill, interview).

Donna is an African-American female in her early 20s who graduated from a neighboring large southeastern university with a four-year mathematics education degree. She chose this university because it was one of the only universities that had a degree in mathematics education. As part of a full scholarship program in return for four years of teaching in the state public school system, she earned a degree in mathematics education and is now a second year teacher in a high school just a few miles away from her alma mater. Donna was interested in teaching first; the subject that she taught came secondary. She had strong mathematics teachers in high school. Like Bill, she had always enjoyed and performed well in math. She currently teaches Pre-Algebra and Algebra II. She realized in college that the reason she had always enjoyed mathematics was because she did well in it and "could just do what the teachers did on the board" (Donna, interview). When she arrived in her methods courses, she was interested in learning how to actually teach the mathematics to others that she had so easily performed herself as a student. Donna enjoyed and performed well in the mathematics, but she even more enjoys her students and how to help them learn that mathematics: "I enjoy most building relationships with my students and pouring into their lives. Even more so than the math" (Donna, interview).

The University of Caston & Caston State University: The programs

As stated earlier, Bill and Donna graduated from different mathematics education programs, both at large southeastern universities. Bill graduated from the University of Caston and Donna graduated from Caston State University.

The University of Caston (UC) does not offer a four-year degree preparing secondary teachers. In order to earn a secondary teaching license from this

university, a degree in the subject matter must first be earned, and then the completion of a summer-through-the-next summer Master of Arts in Teaching (MAT). The students enter and end the program as a cohort (Tom, 1997) who take all specialty courses (e.g. mathematics education courses) together. The culture of this university is for students to be full-time students. The students begin the program in the summer taking two introductory education courses, followed by a full load in the fall with one course in their content area. In the spring, the students take a brief educational psychology course, followed by their student teaching experience, and conclude with a follow-up brief reflective methodology course. In the summer, they complete two more education courses. The entire curriculum is listed in Appendix B.

Caston State University (CSU) offers a four-year degree in mathematics education. There is no deliberate cohort structure for the students in this program. The culture of this university is for some students to be full-time and others to be part-time so students begin and end the program when they complete the requirements, not necessarily in the specified four years of the program (see Appendix C). The first two years consist mostly of general education courses with the inclusion of four mathematics courses and one mathematics education course. The junior year includes two mathematics courses and two mathematics education courses. Student teaching takes place during the fall semester of the senior year, with a brief mathematics education course before and a brief mathematics education course after. Education courses fill the last semester of the senior year. Students take six electives throughout the four years determined by which specialty area they choose: mathematics, statistics, or computers. The entire curriculum is listed in Appendix C. It is important to note that both curriculums include equivalent hours in mathematics even though CSU includes pedagogical content courses.

Study Context & Research Methods

A convenience sample was used in which faculty at each institution recommended a second year teacher based on their knowledge of which graduates were still teaching in the area. A small sample size of two teachers was chosen to allow for an in depth interview with each teacher. A larger sample size would allow for a more generalizable study, however would have decreased the amount of detail gathered each teacher. The high schools in which the teachers taught were similar: large suburban high schools with students ranging from low socio-economic to high socio-economic. One to two hour interviews (Appendix A) were conducted with each teacher at the high school where they taught. Each interview was audio recorded and transcribed. Field notes were taken during the interviews and during document review. Document review (Appendices B & C) of printed and online documents of each institution's teacher preparation program were conducted and used to triangulate with what the teachers said in their interviews. Interview transcriptions were coded and common themes emerged from across each interview. The printed and online documents were compared to those themes and from that triangulation, conclusions were drawn with consideration to the research literature.

Mathematics & Teaching: The comments

Bill and Donna both spoke highly of their teacher preparation programs. Each offered suggestions, looking back, they think might have been beneficial. As practicing teachers, each understood that there was only so much that could be done in the classroom setting. The comments made by Bill and Donna clustered around three main areas: mathematical preparation and support, on-the-job knowledge, and possible suggestions for improving their teacher education programs.

Mathematical preparation and support: feeling "really prepared". Mathematical preparation and support was a topic that both Bill and Donna discussed. Both commended the preparation and support they received.

Donna specifically chose CSU as she wanted an integrative approach involving both the mathematics and how to teach the mathematics.

> Especially if you were just majoring in math, you were just doing math and you really need, what's the best way to teach it. Just learning more from the student's perspective rather than you just doing math yourself. That's what I was trying to avoid, just taking math classes. Obviously you do well in math or you might have liked math, that's why you're teaching it, but I would like to have known more about what kinds of problems you're going to face in the classroom. And I think CSU did a good job with that. And my concern if you were just majoring in math and just majoring in education, would you get those kinds of things? (Donna, interview)

However, she mentioned that she did not feel "really prepared" until her student teaching experience when she taught "actual courses you teach in high school" (Donna, interview). Donna commended the program for its emphasis on the teaching and purpose of the mathematics:

> I think that was the strong part that the program did have. They really did want you to learn how you can best teach math. Even if the concepts are different, the ideas of how you teach math are the same and they really stressed that a lot. Why are you doing this activity and how does that help them learn? And how does it fit into the curriculum? You always had to answer why you are doing what you're doing? Does it really benefit the students or are you just doing it to fill time? (Donna, interview)

Donna felt that she built strong relationships with her professors, specifically her education professors. They were "more than happy to help, especially during student teaching" (Donna, interview).

Bill recalled a course that bridged the mathematics classes he had taken as an undergraduate with the teaching of mathematics. He referred to the course as "Math Teacher 101" (Bill, interview). He appreciated the support he received from both his advisor and cooperating teacher.

> Math Teacher 101, different styles of teaching, how you would present this type of lesson to a class. We talked about Piaget; we talked about several of those guys who did educational theory. . . . We had to make observations, at some point, teach a lesson. Then we had to present that lesson to our cohort. At the same time we were taking other classes which are cross disciplinary, several math kids, several social studies, music. Spring, we came back and took a 10 day class with just our cohort, the math cohort, it was sort of preparation, make-sure-you- know-what-you're-doing type of class. Then we had 12 straight weeks of student-teaching. . . . Across the board, what most of our cooperating teachers did was ease us in and pull us out easily, meaning the second week we would get a class. The next week we would have all of our teachers' geometry classes. And then they would slowly start to pull us in so that the third or fourth week, we were teaching every class, every day, coming up with our own lesson plans, coming up with tests, coming up with quizzes. We were grading. We were doing the admit slips, the paper work, everything. And our teacher would just sit back and be a constructive criticism type of cheerleader. "I liked it." My teacher was great in that when I came back to the desk, there were post it notes. Just from notes she had written down: I like this, This was terrible, Fix this. [Our advisor] took extra care to put us with a teacher where she thought our personalities would match. (Bill, interview)

Donna and Bill spoke extensively about the benefits of their student teaching experiences and the importance of the support received from both their university supervisor and cooperating teacher. Bill best summed up the support felt by these two during their pre-service experience: "They [university supervisors] sat and listened. And that is something to this day I will never forget" (interview).

On-the-job knowledge: "knowing it and seeing it are two different things".

> When I got here, I knew that those things were there, but I wasn't exactly sure how it all worked together. I didn't know about certain things, about the security guards, and what they do, the resource officers, versus the people that are on standby for fire drills and things or how ISS works or—[BUZZ—intercom announcement]—how that works! Knowing it and seeing it are two different things! (Bill, interview)

This "on-the-job knowledge" that Bill expressed was also spoken of by Donna. Most of the aspects they referred to have little to do with their mathematical knowledge and more to do with the every day workings of a school. Whereas Bill spoke more about the operations of the school, Donna's comments were more directed toward building relationships with her students.

One course Bill discussed began to introduce these varied aspects of the school. It was one of the first courses in his MAT program.

> Intro to Schools, Intro to Education type of classes. Basically took a history of schools: how schools came to be, the different types of schools, all about a school. If you don't know, here's what a school is, here's how it's run, here's who runs it, here's where the money comes from, just every aspect, as a teacher, you would never stop to figure out. It was nice to know all the stuff that factored into it.

Donna spoke of the difficulties in relating to her students and their varying needs that have little to do with the mathematics. She remembers taking a course that she felt most prepared her to work with a wide variety of students entitled "Teaching Diverse Populations," which was an elective, not a requirement.

> You can learn all this math stuff, how to teach it, how to best present it, but that's the least of my troubles, now. Just how to present it or how to teach it. One because I teach low level classes and two, this is the last thing, far from their minds. The problems that I'm experiencing now have nothing to do with math and I didn't get prepared, I wasn't prepared for those things. . . .What do you do for kids that really just don't care? That takes up more of my time than anything else. Discipline and kids coming to school not prepared and unmotivated. And what do you do?

Suggestions for teacher education programs. Bill and Donna offered three suggestions for teacher education programs. Consistent with their expressed feelings and the two previous themes of this paper, the suggestions had more to do with teaching in general than with their content area of mathematics. As each felt strong mathematical preparation and support to convey the mathematics to their students, each felt less prepared for the on-the-job knowledge of teaching.

First, small teacher education class sizes were suggested so that students could ask more direct questions and have more of an opportunity for dialogue. Smaller classes allowed students to "really let us say what we wanted to say" (Bill, interview).

Second, more observations in diverse settings would allow for a broader picture of what schools are truly like. "I want to observe a math class at Dorjan and at Sillhide and in Range county, all very different" (Bill, interview). Seeing these different settings would balance the "idealistic university world of education where all the kids will be completely and totally motivated to learn and you would be completely and totally motivated to teach and have all this time to put people into groups" (Donna, interview).

Third, incorporate a mentoring aspect into teacher education programs where pre-service teachers mentor a high school student. Emphasis is placed on the word mentoring meaning a more involved role than a weekly tutor.

> More tutoring, some kind of mentoring where you just see what these kids are about. Just get an idea of what's in their head,

> what's going on with them. It seems like that would at least give you an idea of what to expect. Exposing, observing a class like I'm teaching now [introductory mathematics course]. (Donna, interview)

Discussion & Synthesis

Feeling mathematically prepared and supported, needing more on-the-job knowledge, and offering suggestions for teacher education programs summarizes the three main themes discussed by Bill and Donna. Findings about the strengths of both teacher education programs emerged from these themes.

The University of Caston is more theory-based whereas Caston State University is more practice-based. As UC offers a bigger picture to its students about the world of education, sometimes that bigger picture falls short of offering practical suggestions on how to deal with the daily struggles of a teacher. As CSU offers a more practitioner friendly program of how to teach mathematics to teenagers, sometimes that subject specific knowledge falls short on the bigger picture of how to deal with students from diverse backgrounds.

The University of Caston's MAT program brings students from six different subject areas together allowing for conversations across disciplines and a broader view of the people who work in schools.

> I like to hear other peoples' sides and you put math teachers with a bunch of English teachers, with a bunch of social studies teachers, and they're going to be, not liberal versus conservative, but they're going to be the liberal type of teachers. We don't believe in disciplining our kids very hard, and our math teachers are sitting over there and we're like, "You have to." Well we don't want to teach straight through the book, "Well, we have to." And it gave us a chance to really pick each others' brains. With the math teachers, even though we all had different philosophies, we all had the same base set of ideals and what we wanted for our classrooms. Whereas these teachers we would kind of look at them and say, what in the world, but it gave us a chance to voice our opinions and also listen to theirs. . . . there were six groups [of subject specialties] and it seemed like every group had a different take on—we got into discussions about core subjects versus the fine arts and cultural arts, and that was a huge debate, and as core curriculum people, we were like, cut this out, cut this out, and they're saying, what a minute, you can't do that, because that's important for kids who aren't good in math and who aren't good in science and history, and English. Those were really nice in that they were really diverse. It often led to heated arguments and things of that sort, but we also took away from it that we were better educated than we were the day before. (Bill, interview)

This interdisciplinary aspect of the UC program attempts to guard against the departmental allegiances that Siskin (1994) warns about in secondary schools that can interfere with the education of children.

As CSU is a four-year degree program, conversations around mathematics education are frequent. Discussion about connections between mathematical concepts take place and students have an extended time to think about these connections.

> One big thing was making connections because math, especially, is a subject where it builds on, so they do have some previous knowledge of something. You might know how to add; today you're going to learn how to multiply. If you can understand how to add, then you can understand how to multiply, because multiplying is just adding. Taking something that they already know and helping them to use that to move forward. That is something they always talk about, making connections. And also, more of an investigations or exploratory activity where they're actually doing things on their own or hands on. Students are supposed to learn math better when they are actually doing it themselves rather than you just telling them, "This is what you do it." But when you have them take that prior knowledge and have them stretch it in order to do the new concept, then they really get it. If they really understood what they were doing before, and they would just apply that knowledge or stretch that knowledge, then they'll get what their doing that day. . . . Getting them to take what they know and how can we tweak it and what kind of questions can we ask so that they're really answering these questions that we're going to ask today. (Donna, interview)

Bill appreciated his one-year experience in an MAT program as he learned the essentials for being a teacher and did not have to wait another year to apply this knowledge. Donna appreciated her experience in a four-year undergraduate degree program as she felt she was able to make connections between the content knowledge and the pedagogical content knowledge.

It is also interesting to note that much of the struggles that Bill and Donna experienced fell more into the "general" category of education than they did into the "specific" category of *mathematics* education and are consistent with the research literature. Both teachers did not feel challenged or uncertain in their mathematical knowledge, but more so in their "withitness" (Kounin, 1970; Johnston, 1995). Johnston (1995) describes withitness as good timing, targeting, monitoring, and reacting. Extending this definition to include an overall awareness of the classroom, the students, and all the outside influences that affect both, Bill and Donna's reflections and suggestions for teacher education program improvement centered around this withitness. Bill used talking about withitness when he spoke of "on-the-job knowledge." As Rogers and Babinski (2002) have recognized with their work with new teachers:

> Teaching is a demanding and at times debilitating job that requires extraordinary expertise in human relations, tremendous organizational abilities, profound patience, and the wherewithal to make hundreds of situation-specific decisions over the course of a school day. (p. 1)

As both Bill and Donna allude, there is a unrealistic expectation that all teachers should transition from college student to expert teacher as soon as they enter the classroom (Lortie, 1975). Although this expectation has improved since Lortie's 1975 comment, Bill and Donna tell us that more work needs to be done to better align what preservice teachers learn in preparation to what they will face as inservice teachers.

Huberman's (1989) work on the professional life cycle of teachers resonants with the pictures painted by Bill and Donna about their personal experiences. In what Huberman (1989) would call "survival and discovery" and then "stabilization" (p. 33), Bill and Donna are in the first two phases of their professional life cycle.

> At the phase of career entry, where empirical research is most plentiful, we find the recurrent themes of "survival" and "discovery." The survival theme has to do with reality-shock, especially for teachers with no prior teaching experience, in confronting the complexity and simultaneity of instructional management: the preoccupation with self ("Am I up to this challenge?"), the gulf between professional ideals and the daily grind of classroom life, the fragmentation of tasks, the oscillation between intimacy and distance with one's pupils, the apparent inadequacy of instructional materials give the diversity of pupil characteristics – the list goes on.
>
> On the other side of the ledger, the discovery theme translates the initial enthusiasm of having one's "own" pupils; one's own classroom, materials, and yearly program; and of feeling oneself a colleague among peers. Some of these studies suggest that the survival and discovery dimensions coexist, and that the latter allows the novice teacher to tolerate the former. . . .
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> The succeeding phase brings us directly to the classic life-cycle literature and its treatment of commitment, stabilization, and "taking on adult responsibilities." In particular, authors in the psychoanalytic tradition have stressed the significance, in the "healthy" process of ego development beyond adolescence, of making a commitment to a defined professional role. (pp. 33-34)

As Huberman's (1975) life-cycle supports, evolution is a part of a teacher's professional life. Although Bill and Donna and other new teachers progressing (what feels like rapidly) through this life cycle may disagree, Lortie (1975) begins his 2002 publication of *Schoolteacher* with the sentence, "Education does not change at a rapid pace" (p. vii). Fortunately, although the change may be gradual,

Korthagen and Kessels (1999) suggest recent research in mathematics education does indeed offer a model for future change and research in mathematics teacher education. Talk to preservice teachers and find out what they know and what they do not know. Involve preservice teachers in the process of improving the teaching of pre-service mathematic teachers. What has worked for them? What has not worked for them? With their involvement, teacher education programs will continue to improve.

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Appendix A

Secondary Math Education Teacher Preparation Programs
Interview Protocol

1. Introductions

2. Why did you choose to go into Math Education?

3. Tell me about your program at UC/CSU.

4. Ask CSU: At UC, the teacher preparation program is a 5-year MAT (Master of Arts in Teaching) program. What are your thoughts about that in comparison to your experience? [Share with them the UC list of courses]

   Ask UC: At CSU, the teacher preparation program is a 4-year undergraduate degree. What are you thoughts about that in comparison to your experience? [Share with them the CSU list of courses]

5. What were the strong aspects of your program at UC/CSU?

6. What did you consider to be the weak points of your program at UC/CSU?

7. Now that you are in your second year of teaching, reflecting back on your teacher preparation program, what part of the program *most* prepared you for teaching?

8. Now that you are in your second year of teaching, reflecting back on your teacher preparation program, what part of the program *least* prepared you for teaching?

9. What courses are you teaching? Did you feel knowledgeable in the content you were expected to teach? Why? Did you feel prepared to teach the content you were expected to teach? Why?

10. If you could modify your teacher preparation program, how would you modify it? (e.g. add a course (what type of course) or take away a course) Why?
11. What pressures do you feel as a new teacher coming from a teacher preparation program that discussed reformed based mathematics into a school that may or may not teach with those same reform ideas?
12. What has surprised you the most in your first two years of teaching?
13. In what ways do you see yourself as a leader (in your classroom, in your school, in your district, other)? Do you view other teachers in your school as leaders and why? What aspects of your teacher preparation program encouraged you or prepared you to be a leader?
14. In what ways do you see that teachers can become leaders?

Appendix B

The University of Caston

Mathematics Teacher Education Curriculum (Master of Arts in Teaching)

Prerequisite:

Students who enter the M.A.T. in mathematics should have bachelor's degree with a mathematics major or its equivalent (30 credits). Preferred courses are: Calculus I, Calculus II, Calculus III, Differential Equations, Advanced Calculus, Discrete Mathematics, Euclidean and Non-Euclidean Geometry, Statistics, Linear Algebra, Modern Algebra, Number Theory. Other suggested courses to complete the 10-course mathematics major are: History of Mathematics, Matrix Algebra, Topology and Probability.

Program Curriculum:

[Key: Course Title (Number of credit hours)]

Summer I

Introduction to Teaching (3 hrs)
Introduction to Schools (3 hrs)

Fall

Learner and Learning I (3 hrs)
Contexts of Education (3 hrs)
Practica Student Internship (3 hrs)
Methods and Materials for Teaching Secondary/K-12 Subjects I (3 hrs)
Course in Advanced Mathematics (3 hrs)

Spring

Learner and Learning II (2 hrs)
Practica Student Internship (9 hrs)
Methods and Materials for Teaching Secondary/K-12 Subjects II (2 hrs)
Teaching Secondary Students with Disabilities (1 hr)

Summer II

Advanced Pedagogy (3 hrs)
Curriculum Leadership (3 hrs)

Appendix C

Caston State University

Mathematics Teacher Education Curriculum (Bachelors in Science in

Mathematics Education)

[Key: Course Title (Number of credit hours)]

FRESHMAN YEAR	
Fall Semester	*Spring Semester*
Academic Writing & Research (4 hrs) Calculus I (4 hrs) Logic (3 hrs) Statistics by Example (3 hrs) Intro to Computing Environment (1 hr) Physical Education (1 hr) Orientation to Math/Science Education (0 hrs)	Calculus II (4 hrs) History Elective[1, 2] Philosophy, Religion, Fine Arts Elective[1, 2] (3 hrs) Intro to Computers - FORTRAN or JAVA (3 hrs) Physical Education (1 hr)
SOPHOMORE YEAR	
Fall Semester	*Spring Semester*
Calculus III (4 hrs) Science[3] (4 hrs) Literature Elective[1, 2] (3 hrs) Required Specialty Course[5] (3 hrs) Social Science Elective[1, 2, 11] (3 hrs) Required Specialty Course[5] (3 hrs)	Required Specialty Course[5] (3 hrs) Science[3] (4 hrs) Intro to Math/Science Education (3 hrs) Intro to Math/Science Education Lab (0 hrs) Speech Elective (credit hrs missing in literature)
JUNIOR YEAR	
Fall Semester	*Spring Semester*
Educational Psychology (3 hrs) 0 Multicultural Education Elective[2] (3 hrs)	Orientation to Math/Science Education (0 hrs) Foundations of Euclidean Geometry (3 hrs)

Introduction to Modern Algebra (3 hrs) Science[3] (3-4 hrs) Required Specialty Course[5] (3 hrs)	School and Society (3 hrs) Required Specialty Course[5] (3 hrs) Teaching Math with Technology (3 hrs) Tutoring Adolescents (1 hr) Humanities/Social Science Elective[1, 2] (3 hrs)
SENIOR YEAR	
Fall Semester	*Spring Semester*
Methods and Materials in Math[7, 8] (3 hrs) Student Teaching Math[7] (8 hrs) Teaching Math Topics in Senior High[7, 8] (3 hrs)	Required Specialty Course[5] (3 hrs) Teaching Exceptional Children in Mainstream Classes (3 hrs) Free Electives (6 hrs) Psychology of Adolescent Development (3 hrs) Science, Technology, Society Elective[10, 2] (3 hrs)

Footnotes:

Note: * Computer Specialization must take JAVA and *not* FORTRAN.

1. Must be chosen from university's official lists for the humanities and social sciences elective courses.

2. At least one of the indicated courses must focus on a non-English speaking culture.

3. Must choose one from a chemistry or physics two-course sequence and a third course may be chosen from any other natural science.

5. Students are required to take 18 semester hours in one of the three specializations in the mathematical sciences.

7. Offered only in Fall Semester. Prior admission to Professional Semester required.

8. A grade of C or better must be maintained in course prior to student teaching in order to be placed in a school setting.

9. Students must meet the university requirements for foreign language.

10. Must be chosen from the university's official list for the humanities and social science perspective elective courses.

11. Social science elective cannot be a Psychology course.

For licensing, a grade of D is not accepted in any required course.

Specializations	
Mathematics Specialization	
SOPHOMORE YEAR	
Fall Semester	*Spring Semester*
Foundations of Advanced Math (3 hrs)	Applied Differential Equations I (3 hrs) Mathematics Elective (3 hrs)
JUNIOR YEAR	
Fall Semester	*Spring Semester*
Free Elective (3 hrs)	History of Mathematics (3 hrs)
SENIOR YEAR	
Fall Semester	*Spring Semester*
No requirement	Intro to Linear Algebra Matrices (3 hrs)
Computer Specialization	
SOPHOMORE YEAR	
Fall Semester	*Spring Semester*
Programming Concepts – JAVA (3 hrs)	Computer Organization and Assembly Language for Computer Scientists (3 hrs) Discrete Math for Computer Scientists (3 hrs)
JUNIOR YEAR	

Fall Semester	*Spring Semester*
Data Structures for Computer Science (3 hrs)	Computer Science elective (3 hrs)
SENIOR YEAR	
Fall Semester	*Spring Semester*
No requirement	Elementary Linear Algebra or Intro to Linear Algebra & Matrices (3 hrs)
Statistics Specialization	
SOPHOMORE YEAR	
Fall Semester	*Spring Semester*
Statistical Methods I (3 hrs)	Statistical Methods II (3 hrs) Foundations of Advanced Math (3 hrs)
JUNIOR YEAR	
Fall Semester	*Spring Semester*
Intro to Math Statistics I (3 hrs)	Intro to Math Statistics II (3 hrs)
SENIOR YEAR	
Fall Semester	*Spring Semester*
No requirement	Elementary Linear Algebra or Intro to Linear Algebra & Matrices (3 hrs)