

COMMENTARY

Census of Mathematics Content and Methods Courses in Kentucky Elementary Teacher Preparation Programs

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Abstract

Despite long-established standards for the number and type of courses recommended for the preparation of elementary mathematics teachers (CBMS, 2012; AMTE, 2017), relatively few teacher preparation programs in the nation meet those standards (e.g., Bertolone-Smith et al., 2023). This census study of Kentucky's elementary teacher preparation programs represents a beginning step to assess where the commonwealth's programs stand with respect to the established standards. The number and type of mathematics courses for each elementary teacher preparation program in Kentucky were gathered, as well as the associated course descriptions. Trends, similarities, and differences in the program structures are discussed. Ultimately, no program in Kentucky meets AMTE's current standards. Ideas for adjusting this status quo and facilitating communication between programs are discussed.

Keywords: elementary teacher preparation, teacher preparation standards, mathematics content courses

Both the Conference Board of the Mathematical Sciences (CBMS, 2012) and the Association of Mathematics Teacher Educators (AMTE, 2017) have set standards for the mathematical preparation of elementary teachers. The CBMS (2012) standards include mathematical domains of which elementary teachers should have deep knowledge (counting and cardinality, operations and algebraic thinking, number and operations in base ten, number and operations—fractions, measurement and data, and geometry) as well as recommendations for elementary teacher preparation programs and the professional development of practicing teachers. The AMTE (2017) standards build on the CBMS (2012) standards by addressing the “knowledge, skills, and dispositions” (p. iii) mathematics teachers should have with specific elaborations for differing grade bands. Most relevant to this article, the AMTE standards state that “Because well-prepared beginning [upper elementary] teachers must have substantial mathematical knowledge and skills as well as sound mathematical dispositions, programs must include 12 credits of coursework from a mathematics department” (2017, p. 89). Recent studies (Bertolone-Smith et al., 2023; Masingila & Olanoff, 2022; Masingila et al., 2012) have found that few teacher preparation programs meet those standards.

Recent changes to the commonwealth's higher education funding model by the legislature have the effect of increasing competition between the state's public universities (Kentucky Council on Postsecondary Education, 2022). While funding was previously based on each institution's then-existing share of the higher education budget, the new performance funding model awards funding to institutions proportionately based on several metrics including student progression, degrees awarded, etc. Those institutions that do better on the metrics see a funding increase, while those institutions that do not do as well may see a funding decrease. Despite being placed in more direct competition with respect to student recruitment and outcomes, it may be useful to teacher preparation programs in the state to cooperate and learn from each other in order to attempt to meet the above-mentioned standards for the mathematical preparation of

teachers. Currently, there is no one source of information on the structure of the state's various teacher preparation programs with respect to their mathematical preparation of elementary teachers. This census study is an attempt to fill that gap and facilitate communication.

Method

After eliminating universities and colleges solely devoted to topics unrelated to elementary teacher preparation (e.g., law schools, dental schools, etc.) and two-year colleges, all remaining Kentucky schools' websites were searched to determine if they had undergraduate elementary teacher preparation programs. For schools with multiple elementary teacher preparation pathways, the most generic pathway was chosen for analysis. For example, where applicable, stand-alone elementary teacher preparation programs were considered instead of combination elementary/special education teacher preparation programs. Also, for programs that require students to choose an area of emphasis (e.g., mathematics, social studies, science, etc.), the emphasis area with the fewest mathematics content and methods courses was chosen. This decision was made to help ascertain what the least mathematical training a teacher graduating from the program who would be certified to teach elementary mathematics would have.

Once it was determined a school had an elementary teacher preparation program, the following data were collected: the number of required mathematics content and mathematics methods courses, the associated course codes (e.g., MATH 205), course names, and course descriptions. In the process of recording required mathematics content courses, only those specifically for pre-service elementary teachers were considered. Other mathematics courses needed to fulfill general education requirements, such as college algebra, and mathematics courses that may be required for a degree but that were not specifically for elementary teachers were not considered for this study.

Results

Twenty-six Kentucky colleges or universities were identified as having elementary teacher preparation programs. Those schools, along with their distribution of mathematics content and methods courses, are listed in Table 1 below. The total enrollments of the schools vary greatly. For comparison's sake, the enrollment rankings of the eight largest schools are indicated in parentheses. After these eight schools, there is an enrollment drop off of over 50% before the ninth school.

Table 1. Schools' Mathematics Content and Methods Courses.

School	Total Courses	Distribution
Eastern Kentucky University (5)	4	3 content, 1 methods
Kentucky Wesleyan College	4	3 content, 1 methods
Morehead State University (8)	4	3 content, 1 methods
Northern Kentucky University (4)	4	3 content, 1 methods
Western Kentucky University (3)	4	3 content, 1 methods
Murray State University (7)	4	2 content, 2 methods
University of Louisville (2)	3.3	2 content, 1.3 methods
Bellarmino University	3	2 content, 1 methods
Brescia University	3	2 content, 1 methods
University of the Cumberlands (6)	3	2 content, 1 methods
Georgetown College	3	2 content, 1 methods
University of Kentucky (1)	3	2 content, 1 methods
Kentucky Christian University	3	2 content, 1 methods
Kentucky State University	3	2 content, 1 methods

Lindsey Wilson College	3	2 content, 1 methods
Midway University	3	2 content, 1 methods
Spalding University	3	2 content, 1 methods
Thomas More University	3	2 content, 1 methods
Asbury University	3	3 integrated content/methods
Union College	2	1 content, 1 methods
Alice Lloyd College	2	2 integrated content/methods
Berea College	2	2 integrated content/methods
Boyce College	2	2 integrated content/methods
University of Pikeville	2	2 integrated content/methods
Transylvania University	2	2 integrated content/methods
Kentucky Mountain Bible College	1	1 integrated content/methods

A few unusual situations in the table above are worth noting. First, Kentucky Mountain Bible College's teacher education program does not lead to licensure for teaching in public schools in Kentucky. It does, however, lead to certification by the Association of Christian Schools International (ACSI). Therefore, graduates can teach in ACSI affiliated schools. Also, Boyce College's program allows students to choose whether they wish to pursue Kentucky public school teaching licensure or ACSI certification. Those choosing to pursue the public teaching route are required to take two mathematics content courses, but those opting for ACSI certification are only required to take one mathematics content course. Finally, in the case of the University of Louisville, the course description of their initial three-credit hour mathematics methods course does not mention any field placement in schools. The associated placement occurs in a separate one-credit hour course that may be taken concurrent with the methods course or after its completion. Hence the 1.3 methods courses listed in Table 1.

From Table 1, it can be seen that two content courses and one methods course is the most common arrangement. Schools that do this include the largest university in the state, the University of Kentucky. Most of the rest of the largest schools in the state, along with Kentucky Wesleyan College, have four courses devoted to the mathematical preparation of elementary teachers. Most of these schools have three mathematics content courses and one methods course. Murray State has two content courses and two methods courses. Several schools have chosen to integrate their content and methods courses; however, the largest of the schools who structure their programs this way are the University of Pikeville and Asbury University, both with a total university enrollment of approximately 2,000 students. So, while this integrated experience is an option for aspiring elementary teachers in Kentucky, it is not available to many.

Most course names were non-specific and gave little indication as to the content covered in the course (e.g., Math for Elementary Teachers I). Only Northern Kentucky University and Western Kentucky University had specific course names for all their content courses. These are shown in Table 2 below.

Table 2. Schools with Specific Content Course Names.

School	Courses
Northern Kentucky University	Arithmetic Structures for Elementary Teachers Geometry I for K-8 Teachers Probability and Statistics with Elementary Education Applications
Western Kentucky University	Number Systems and Number Theory for Teachers Fundamentals of Geometry for Teachers Rational Number and Data Analysis for Teachers

In analysis of the course descriptions, the programs with three content courses were generally more likely to specifically consider fractions and statistics than programs with fewer content courses. Among schools with three content courses, Kentucky Wesleyan College was unique. Their first two content courses had descriptions similar to those of other schools that have two content courses. The third course was entitled Verticality of the Math in Pre-K-12 Curriculum. The course description read, in part, "This course will insure pre-service teachers have a sense of how concepts are introduced in the elementary curriculum and then woven through the middle/high school curriculum. The vertical nature of mathematics will be studied from fractions and decimal [sic] through algebra" (Kentucky Wesleyan College, 2022, p. 206).

In general, however, the analysis of the course descriptions was complicated by the great variance in size and specificity among the various programs' course descriptions. For example, Bellarmine University's (n.d.) second content course's description states in part,

Next, the study of geometry begins with examination of the basic shapes of one, two, and three dimensions and is followed by an investigation of the basic ways these shapes can be transformed: translation, reflection, and rotation. The study of basic measurement including length, area, surface area, and volume completes the content of this course. (para. 1)

On the other hand, Northern Kentucky University's second content course's entire description is "Elements of geometry" (n.d., bullet 30). It seems likely that Northern Kentucky University's course would cover most or all of the topics listed in Bellarmine's course description, particularly since Bellarmine's course includes other non-geometric topics while NKU's course focuses solely on geometry; however, this cannot be gleaned from the course descriptions alone.

Discussion

The first striking result from the data is that none of the programs meet the call for 12 credits of coursework from a mathematics department (AMTE, 2017). That said, one potential reason for this is a misalignment between the organization of AMTE's *Standards for Preparing Teachers of Mathematics* and Kentucky's public teaching licensure system. The AMTE standards are divided into standards for Pre-K to grade 2 and standards for upper elementary grades. Meanwhile, most of the teacher preparation programs considered in this study are designed to lead to state certification to teach Pre-K to grade 5.

One teacher preparation program in the state has taken a unique route to mitigate this misalignment. Asbury University's program stands out in several ways. They are the only program in the state to have both integrated content and methods courses and have a total of three such courses. Furthermore, the course sequence is structured so that the first course considers content and methods relevant to grades K-2, the second course considers content and methods relevant to grades 3-4, and the third course considers content and methods for grades 5-7. While the grade bands of the courses do not perfectly align to the AMTE standards, this program structure comes closer to potentially aligning with the standards' grade bands than any other program.

Despite the general misalignment between the standards and the preparation programs, even if only the upper elementary standards are considered, "12 credits of coursework from a mathematics department" (AMTE, 2017, p. 89) and one methods course are recommended. With almost all preparation programs consisting of three-credit content courses, this would mean four courses in a mathematics department in addition to a methods course. No program in the state meets that standard. This is problematic in a number of ways. First, in conducting the census of the elementary teacher preparation programs, the author noted that each program was rather

heavy on credit hours. Therefore, it is most often not merely an issue of needing to add an additional mathematics course, but also likely removing another course. For the smaller religious schools who have required religious courses in addition to typical general education and teacher preparation programs, the problem is even more difficult. There is perhaps some room in most programs to forego a non-education related general education mathematics course in favor of another mathematics content course for teachers.

Second, with no extant examples in the state of how to structure an elementary teacher preparation program to both meet the CBMS (2012) and AMTE (2017) standards and Kentucky's teacher certification standards, it becomes more difficult to imagine how to meet this goal. Furthermore, with no other programs in the state meeting the standards, there is likely a lack of urgency to find a way to do so, or perhaps to even see this as a problem.

Recommendations and Future Directions

Considering all of this, the author offers two recommendations. First, a regularly updated, public, online repository of standardized information concerning how Kentucky teacher preparation programs approach the mathematical preparation of their elementary teachers would be useful. Such a website could consist of all the data gathered for this study (required courses, course descriptions, etc.), but also more detailed information. For example, syllabi could be included or linked to in order to provide more nuanced information than the course descriptions alone. Furthermore, the website could show the differential mathematics requirements for various tracks and emphases that some elementary teacher preparation programs have. Second, a statewide conference of mathematics educators and elementary teacher preparation program leaders could be convened for the purpose of comparing each other's programs and collaborating to improve them. Even though we live in an era of enhanced competition between programs, all of Kentucky's teacher preparation programs are working toward the same goal of mitigating the state's teacher shortage. Cooperating to produce the best mathematics teachers possible to meet that shortage would be a win-win proposition for all stakeholders.

Limitations

The author attempted to be quite thorough in collecting the most recent and correct corresponding publicly available data from each school's website; however, variances in the quality of the schools' websites and the author's ability to navigate them may have led to some errors. The process of data collection also took quite a bit of time. For programs looking to make changes and converse with other programs who are perhaps already doing what they aspire to do, having an online, living repository of standardized program information would be useful.

Furthermore, this study did not consider two significant elements of Kentucky's current system of mathematically preparing elementary teachers. First, while not having a four-year degree program of their own, the Kentucky Community and Technical College System (KCTCS) teaches many 100- and 200-level courses to students who then transfer to four-year institutions in the commonwealth. Due to established transfer agreements and depending on the requirements of the four-year program, all of an aspiring teacher's mathematics courses (particularly the content courses) may be taken at a KCTCS campus. When one or more additional mathematics courses do need to be taken at the four-year institution, the variance in what is taught in the prerequisite course(s) at the four-year institution versus what is transferred in to substitute for those courses from KCTCS can be significant. This can cause problems with respect to success rates for teacher candidates in the remaining mathematics course(s) at the four-year institution. Therefore, considering the formats, structures, and variations in mathematics courses for future elementary teachers across the KCTCS campuses and more

formally comparing them to what is offered at the commonwealth's four-year institutions in a future study would be useful to the field.

Second, and growing in importance, are the various alternative certification programs. The Kentucky Department of Education lists nine different alternate routes to certification (2023). Generally, one must have a bachelor's degree with a 2.75 grade point average to be eligible for an alternative certification program. From there, aspiring elementary teachers can take classes numbered at the graduate level to achieve their certification. Often the number of classes required relating to mathematics content and pedagogy is lower for alternative certification seekers than for pre-service teachers seeking certification through a bachelor's degree program. As just one example, Eastern Kentucky University (n.d.a, n.d.b) requires four undergraduate mathematics courses for elementary teachers (three content, one methods), while their alternative elementary education master of arts in teaching degree requires only two mathematics courses. As these alternative certification programs grow in number and proportion of elementary teachers produced, cataloging their practices with respect to the mathematical education of their candidates will become increasingly imperative.

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