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# Answering the call by developing an online elementary mathematics specialist program

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ABSTRACT

The Association of Mathematics Teacher Educators adopted Standards for Elementary Mathematics Specialists calling for structured preparation of math coaches, specialists, and instructional leaders across the country (AMTE, 2013). The purpose of this paper is to illustrate the structure and design of our fully online Elementary Mathematics Instructional Leader (EMIL) graduate program for inservice teachers aiming to answer the call. Our graduates are teacher leaders and coaches who are responsible for supporting effective mathematics instruction and student learning at the classroom, school, district, or state levels. We will review formative data from our first cohort of graduates, the benefits and drawbacks to providing online (and grant-funded) courses, and the impact of participant attrition. Our goal is to offer guidance and information to other organizations as they move to develop programs of their own.

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## 1. Introduction

In 2012, the Association of Mathematics Teacher Educators adopted the Standards for Elementary Mathematics Specialists (AMTE, 2013). Since that time, states have begun to develop standards-based programs for preparing mathematics specialists. Today, 16 states have developed mathematics specialist certification programs (EMS & TL, 2016). Of the remaining states, eight are currently in the design process. Campbell and Malkus (2011) demonstrated that when mathematics specialists are prepared in programs with rigorous graduate level mathematics and leadership coursework, they have a positive impact on student achievement. As a consequence, it is no surprise that so many states are looking for ways to develop mathematics specialist preparation programs.

The purpose of this paper is to provide an overview for the structure of, and lessons learned from, an online graduate certificate program for elementary mathematics instructional leaders. Our goal is to provide a relevant and timely resource to others that are in the process of defining or expanding their certification programs to include teachers who do not have easy access to professional development. This paper will describe the history and overview of one online, standards-based program. We also present a description of preliminary data surrounding student experiences with the program requirements, as well as reflective commentary about lessons learned, and planned next steps.

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## 2. A brief history of program development

Before the adoption of the Standards for Elementary Mathematics Specialists (SEMS), there was little direction in Oregon for school districts on the role of a mathematics leader. Districts called them Teachers on Special Assignment (TOSAs), leaders, coaches, or specialists and gave them a variety of roles in the buildings. There were no state approved criteria for these positions and qualification processes were often varied and unclear. However, in 2014, using the AMTE Standards as a framework, the State of Oregon provided the option of adding an Elementary Mathematics Instructional Leader (EMIL) specialization to a current teaching license. This specialization includes three requirements: Three years of successful mathematics teaching at the elementary level, a passing score on a state approved Multiple Subjects Examination, and demonstrated competency of the SEMS as determined by successful completion of course work in through a state-approved program.

With the adoption of the state EMIL specialization, districts looked to the regional universities to provide programs to prepare teachers for this specialization. While, Western Oregon University has had a Master of Science in Education degree for many years, there was no specific coursework to prepare elementary mathematics leaders. So in 2014, Western Oregon University developed an Elementary Mathematics Specialist (EMS) standards-based program to prepare mathematics leaders. Oregon is a state with many rural districts that lack easy access to a university. It became clear that if we were to develop a program that would serve all of the state, it needed to be offered fully online.

The graduate Western Oregon University Elementary Mathematics Instructional Leader (WOU-EMIL) certificate program described in this paper was the first approved EMS program in Oregon and the first to recommend teachers for an EMIL specialization. In November 2014, Western Oregon University was awarded a Department of Education grant to fund the preparation of up to 60 teachers as Elementary Mathematics Specialists through the WOU-EMIL program. The Developing Mathematics Instructional Leaders in Oregon (DEMILO) grant includes funds for WOU-EMIL coursework, monthly webinars, and summer workshops. All WOU-EMIL courses were delivered online for the first time starting in the winter of 2014. Currently enrolled teachers include participants in the DEMILO grant as well as non-grant funded inservice teachers who are pursuing the specialization. For the purposes of this paper, we have labeled faculty who teach courses as "instructors," adults enrolled in our program as "teachers," and the children they teach in K-8 schools as "students."

## 3. Overview of our program, courses and philosophy

The SEMS outline the knowledge, skills, and leadership qualities necessary for the roles and responsibilities an EMS professional may assume (AMTE, 2013). At their core, these standards define the knowledge and skills that a specialist needs (Ball, Thames, & Phelps, 2008; Ma, 1999). The SEMS are framed in three domains:

I. Content knowledge for teaching mathematics:
   a. Deep understanding of mathematics for grades K – 8.
   b. Further specialized mathematics knowledge for teaching.
II. Pedagogical knowledge for teaching mathematics
   a. Learners and learning.
   b. Teaching.
   c. Curriculum and assessment.
III. Leadership knowledge and skills.

Campbell and Malkus (2011) identified a correlation between the presence of an elementary mathematics specialist in an elementary school and increased student achievement in mathematics. However, they cautioned that for this correlation to occur, specialists must be well prepared which included extensive training beyond workshops and short professional development experiences. Instead, the authors, along with Campbell and Malkus, contended that an EMS must have successfully completed rigorous, graduate level coursework that addresses the three domains described by the SEMS.

With this research in mind, a collaborative team of three mathematics and mathematics education faculty at Western Oregon University developed a 24-quarter hour graduate EMIL program aligned to the SEMS and to the Common Core State Standards for Mathematics (CCSSM). The WOU-EMIL program consists of eight, 3-credit graduate level courses:

- Mathematics coursework (five courses)
- Counting and Whole Number Operations
- Fractions and Proportions
- Geometry and Measurement
- Statistics and Probability
- Patterns and Algebraic Thinking OR Algebra and Functions

Education coursework (three courses)

- Advanced Content Pedagogy: Mathematics

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**Table 1**
Course Alignment to SEMS.

| Standards for Elementary Mathematics Specialists (SEMS) | Aligned EMIL Coursework |
|---|---|
| I. Content knowledge for teaching mathematics:<br>a. Deep understanding of mathematics for grades K–8.<br>b. Further specialized mathematics knowledge for teaching. | MTH 611 Counting and Whole Number Operations (3)<br>MTH 612 Fractions and Proportions (3)<br>MTH 613 Geometry and Measurement (3)<br>MTH 614 Statistics and Probability (3)<br>MTH 615 Patterns and Algebraic Thinking (3) OR MTH 616 Algebra and Functions (3) |
| I. Pedagogical knowledge for teaching mathematics:<br>a. Learners and learning.<br>b. Teaching.<br>c. Curriculum and assessment. | ED 637 Advanced Content Pedagogy: Mathematics (3) |
| III. Leadership knowledge and skills. | ED 673 Elementary Mathematics Leadership Practicum I (3)<br>ED 609 Elementary Mathematics Leadership Practicum II (3) |

- Elementary Mathematics Leadership Practicum I
- Elementary Mathematics Leadership Practicum II

The program takes seven quarters to complete. The typical schedule is three quarters in the first academic year, a summer quarter, and then three quarters in a second academic year. Teachers in the program usually take one mathematics course at a time until they have finished the five mathematics content courses. Next, they enroll in the Advanced Content Pedagogy course and then take the two Education Leadership Practicum courses in their final term. All of the courses in this program can be applied toward a Master of Science in Education-Elementary Mathematics Instructional Leader (MSED-EMIL) degree as well. Approximately 20% of current WOU-EMIL teachers are also working toward a MSED- EMIL degree.

It was the intention of the program designers to align all courses to the SEMS, while also modeling this program after other teacher leader preparation programs whose graduates have demonstrated a positive impact on student achievement (Campbell & Malkus, 2011). Table 1 illustrates the relationship between the SEMS and the coursework.

Because Oregon includes a large number of rural schools without easy access to a regional university, each course in the WOU-EMIL program is delivered fully online using Moodle as the course learning management system. Successful online courses have a reliable design and include clear instructions for course work and activities, regular interaction with instructors and peers, and meaningful discussions inside and outside of class (Swan, 2002). All of the mathematics courses in the WOU-EMIL program are formatted using similar styles (i.e. modular structures and similar assignment types) for program consistency. The education courses follow another dependable structure, but the nature of the assignments does require some variance. In all of the WOU-EMIL courses, the instructors have prioritized assignments and activities that require meaningful interaction among teachers as well as between teachers and instructors through discussion and feedback.

All of the instructors in the program are tenure-track faculty in the Mathematics Department in the College of Liberal Arts and Sciences or in the Division of Teacher Education in the College of Education. Instructors meet regularly to ensure that course requirements remain rigorous, but that the necessary supports are in place in order for teachers to be successful in spite of working full time. Indeed, Baily and Card (2009) highlight communication and high expectations as two of the eight effective pedagogical practices for effective online teaching.

## 4. The structure of the online WOU-EMIL mathematics courses

Each of the ten-week mathematics content courses has six units: A course introduction week, four two-week course content modules and a final project week. Each unit comes with its own unit outline, resource readings, resource videos, and help forums.

During the introduction week unit, teachers read articles and view videos about the Common Core State Standards for Mathematics. We have found the Hunt Institute case videos especially informative for inservice teachers (The Hunt Institute, 2016). At the beginning of all of our courses we ask the practicing teachers to introduce themselves, to describe their roles and teaching responsibilities and to share a few things about themselves with their classmates. We employ both forum discussions and picture boards to help everyone get a sense of who they are working with in the course and to help build a sense of community.

In each of the mathematics courses, the four content modules are set up with a similar structure. For example, in our Fractions and Proportions course, the four modules are: Understanding Fractions, Fraction Operations, Rates and Ratios, and Percents and Proportions. Each of these modules has the same set of core assignments. To help address our dedication to offering high-level course work, each module begins with initial content readings and a basic competencies quiz. Teachers must earn at least 90% on the quiz to proceed, but otherwise the quiz does not count towards their overall course grade. This foundational review helps the K – 8 teachers align their background knowledge to the level needed in the course, regardless of what might have been their most recent teaching experiences. The online environment is ideal for review since many

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The ratio of red jelly beans to yellow jelly beans in a dish is 3 to 4.

If Greg eats 3 red jelly beans and 6 yellow jelly beans, the ratio of red jelly beans to yellow jelly beans is now 4 to 5. How many red and how many yellow jelly beans were originally in the dish?

a. Use a ratio diagram to solve this question, illustrate and explain.
b. Use an equivalent ratio table to solve this question, explain,
c. Use algebra to solve this question, explain.

**Fig. 1.** The Jelly Bean Task.

resources, at various levels and in various formats – such as videos, readings and practice worksheets – can be included in the course. Teachers have access to a variety of sources useful for reviewing mathematical concepts, and they are encouraged to interact one-on-one with the course instructors if they find an area where they need direct assistance to develop a full understanding.

After the basic competency work, each content module starts with one or two warm up reading assignments to help the teachers begin to think about the module topics, and as a basis for the initial class discussions. At this stage, the real work of the module begins. Teachers are presented with several rich mathematics task explorations that allow them to interact deeply with the mathematics content. In addition, they analyze student work and make possible intervention recommendations. An assignment with specific connections to CCSSM tie all of the module pieces together. Each module ends with a summary assignment that varies from module to module within a course, and can be quite different from course to course. For example, summary assignments include a reading assignment or video to view followed by a discussion, or a brainstorming activity to develop lessons or assignments tied to the module content.

To facilitate online discussions and encourage interactions among the group, teachers are often asked to respond to questions provided during the initial reading or the summary assignment. They are also encouraged to interact in small groups or by reviewing each others' work on class-based activities. We have found that, in addition to making use of the latest advances in technology that are available for online learning, providing sufficient mathematics content review materials, creating effective tasks as the focus of each module, and intentionally requiring collaboration on select assignments, we have been able to effectively deliver the same content in an online environment as we would typically be completed in an in-person class.

For example, in the Rates and Ratios module in the Fractions and Proportions course, teachers work through the basic competencies covering ratio tables and ratio statements, proportions, unit rates, and the connection between ratios and slope. Next, as a warm up activity, they read two NCTM articles that connect ratios to similar polygons and ratios to proportions and graphing. This is followed with rich mathematical tasks on ratios. One mathematics task (Fig. 1) in the Rates and Ratios module is:

Typically, teachers work in teams of four. Each member of the team takes a turn at leading the group in writing a response to the task-based work. They also take turns reviewing the responses written by other team members. This type of peer review helps the entire group assume responsibility for the final product including the accuracy of the work that is presented and the clarity of the communication in the written product. Teachers submit their completed assignments after the peer review process, extensive team discussions, and opportunities to correct errors and address changes necessary for clarity and accuracy. Technology allows teachers to do individual hands-on work and then share their creations with others. In our classes, for example, teachers frequently use manipulatives to model concepts, take pictures of their models, and then embed their photographs in the write up for the assignment.

Helping each other during team discussions with developing a rich understanding of the content was an ideal opportunity for future leaders to work on their leadership skills and develop the skills to form productive professional relationships. There are inherent challenges to building a sense of community in an online environment, but we specifically structured course assignments to address this (Swan, 2002). Furthermore, transitioning from a teacher to a leader/mentor is a complex undertaking. It takes time and practice to develop the specific skills to assume this role in the school building (Campbell, Ellington, Haver, & Inge, 2013).

At the beginning of the course, the teachers struggled with how to provide feedback to each other, especially if they were correcting each other's mistakes. Peer review comments were often along the lines of "The work is mostly accurate, except I would suggest refining your models. Great job!" This is a typical example of a peer review comment made by a teacher who is taking one of the first few courses. Note that the urge to praise a colleague is used to soften the necessary but contradictory suggestion to change a major component of the work.

As the term progressed, teachers become more adept at providing supportive and constructive peer feedback. For example, "Hi – This problem has a lot of things to think about! You've done a good job breaking the main points down into meaningful parts. Looking over the work, I think there are a couple of things that I thought of in a different way and I have different answers than you do in parts b and c." This individual continued to provide feedback by making suggestions to change the responses to parts b and c.

Proving peer review to written responses to course activities gave teachers further opportunities to discuss the mathematics content in the course. Which, in turn, helped the teachers to better understand the content, and also resulted in

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| I made a ratio table | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Red | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 |
| Yellow | 4 | 8 | 12 | 16 | 20 | 22 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 |
| Then I subtracted 3 red and 6 yellow | | | | | | | | | | | | | | |
| Red | 0 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 |
| Yellow | -2 | 2 | 6 | 10 | 14 | 16 | 22 | 26 | 30 | 34 | 38 | 42 | 46 | 50 |
| Now I divided | | | | | | | | | | | | | | |
| R/Y | 0 | 1.5 | 1 | .9 | 12/14 | 15/16 | 18/22 | 21/28 | 4/5 | 27/34 | 30/38 | 33/42 | 18/23 | 39/50 |
| There were 24 red and 30 yellow jelly beans in the dish | | | | | | | | | | | | | | |

**Fig. 2.** Sample student solution to Jelly Bean Task.

higher quality write-ups for the mathematics tasks. In addition to helping teachers improve their skills, this was important because many of the write-ups were included in the teachers' EMIL portfolios.

To ensure that teachers think deeply about the Common Core State Standards (CCSSI, 2011), the WOU-EMIL course design team mapped all of the K – 8 CCSSM content standards into the six mathematics courses. We take connections to the CCSSM standards seriously in our program. Each of our mathematics courses takes a slightly different approach to covering the standards but all courses include assignments that make direct connections to the CCSSM content standards to help teachers develop both a breadth and depth of understanding of these standards. For example, one course might focus on the trajectory of the standards feeding into and out of a particular mathematics task, while another course might focus on the coherence relationships between the standards that may be illustrated by related content tasks.

Although the Jelly Bean Ratio task (see Fig. 1 above) is one of the higher grade-level tasks in the Fractions and Proportions course, and this particular course includes many of the higher level mathematics topics in the EMIL program, the task illustrates how a single question can be explored using a variety of approaches, all of which are grade level appropriate, and all with meaningful connections to the vertical progression of this mathematics topic.

For example, part c, is easily linked to a seventh grade content standard:

**Ratios and Proportional Relationships, Grade 7 (7.RP.2)**

2. Recognize and represent proportional relationships between quantities.

c. Represent proportional relationships by equations (CCSSI, 2011).

However, by including the work with tables (part b), the teachers also understand that this task is related to the fifth grade content standard:

**Number and Operations—Fractions, Grade 5 (5.NV.5)**

5. Interpret multiplication as scaling (resizing), by:

a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication (CCSSI, 2011).

Finally, by starting with ratio diagrams (i.e. tile diagrams), the teachers can connect a seventh grade task to an entire trajectory of elementary school work including this third grade standard.

**Operations and Algebraic Thinking, Grade 3 (3.OA.1)**

Represent and solve problems involving multiplication and division.

1. Interpret products of whole numbers, e.g., interpret $5 \times 7$ as the total number of objects in 5 groups of 7 objects each (CCSSI, 2011).

After solving the task, teachers complete the related CCSSM connections assignment in which they create a learning trajectory of the standards from the second through seventh grade that highlight the various mathematics components of this task and the skills in the earlier grades that children need to know in order to tackle these mathematical ideas. Teachers find sites such as the Achieve the Core Coherence Maps (Student Achievement Partners, 2016) helpful when working through this type of standards-based learning trajectory.

To further their analysis of these foundational mathematical ideas, WOU-EMIL teachers also evaluate the work of an elementary school student on part of this task. For example, when reviewing work by a particular fifth grader, teachers typically will catch a few computational errors made by the student and often link the student's reporting of the incorrect answer to MP1: Make sense of problems and persevere in solving them (CCSSI, 2011). Fig. 2 shows one possible student solution to the Jelly Bean Task.

A different sample of fifth grade work (Fig. 3) often results in teachers searching for ways to help this student with mathematics content errors and fundamental conceptual errors around the idea of ratio.

Although the WOU-EMIL mathematics courses focus on content rather than pedagogy, analyzing student work like the samples presented above enables teachers to further develop their mathematics teaching expertise through a new content-related lens. Through activities like this, the WOU-EMIL program addresses the SEMS 1.b: Specialized content knowledge for teaching (AMTE, 2013).

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I put down 3 red and 4 yellow tiles
R R R Y Y Y Y
There are not enough to take away 6 yellow tiles, so I put down twice as many
R R R R R R Y Y Y Y Y Y Y
I took the 3 red and the 6 yellow tiles out
R R R Y Y
There are not 4 red tiles, so I added 1 more of each
R R R R Y Y Y
The ratio is 4 to 3, 4 to 5 wasn't right.

**Fig. 3.** Another student solution to Jelly Bean Task.

In each course, the last week of term is devoted to final project work. The write-up for the project is due during the week of final exams. This project takes a variety of different forms depending on which course is being offered. The mathematics instructors collaborate to ensure that across the six mathematics courses, projects cover different mathematics content and encourage teachers to explore a variety of leadership tasks. For example, one course might require a CCSSM summary project that encourages teachers to connect elementary school curriculum tasks to the content standards. Another course might ask teachers to design all aspects of "mini-module" including topics for class discussion and mathematics tasks, to teach the module in a colleague's classroom, and to evaluate the resulting student work. Another project requires teachers to orchestrate a whole class mathematics discussion about a mathematics task and present the results to the class (Stein, Engle, Smith & Hughes, 2008).

There are collaborative group assignments in every course in the program. While WOU-EMIL instructors acknowledge that these types of assignments are a challenge for busy teachers they are very effective for helping teachers develop their understanding of the content and the leadership skills necessary to be successful as an EMS. The rich team discussions in which teachers simultaneously support each other while providing constructive feedback on assignments also alleviates the pressure off of many teachers. Prior to implementing a discussion-based approach, teachers seemed to be trying to remember mathematics concepts that they had not studied or taught in several years on their own and perhaps in a vacuum. In fact, we are moving toward incorporating more and more teamwork as we make refinements and improvements to the WOU-EMIL program.

## 5. Advanced education and practicum coursework

After successful completion of the mathematics courses, teachers enroll in the Advanced Content Pedagogy: Mathematics course. This course is open to all graduate students at WOU and fulfills a program requirement for both a Master of Science in Education and the WOU-EMIL program. Course participants are required to be currently licensed teachers. The purpose is to analyze mathematics assessment and instructional practices, including content area literacy, diversity, and technology as they relate to improving learning. Teachers examine and critique current issues and research as well as implications for classroom practice. The required textbooks (Featherstone & Crespo, 2011; Humphreys & Boaler, 2005; NCTM, 2014) are supplemented heavily with additional readings.

Participants in this course analyze a number of video cases of teaching episodes (Humphreys & Boaler, 2005). They read research on specific student misconceptions and apply what they learn by evaluating the ability of mathematics apps to address that misconception. Teachers apply the concepts in the course readings to developing lesson plans as well. Teachers write a problem-based lesson (Stein et al., 2008) and a lesson that incorporates the features of Complex Instruction (Featherstone & Crespo, 2011). Teachers have several options for a final project, but the focus is on creating a product that can enrich the teaching profession, such as an article suitable for publication in a regional mathematics education journal.

In their final term in the program, teachers enroll in two WOU-EMIL Leadership Practicum courses. Practicum I gives teachers the opportunity to develop their leadership abilities through a series of projects. The required textbooks (Campbell et al., 2013; NCTM, 2014) are heavily supplemented with additional readings. Course projects incorporate mentoring individual teachers, professional development for school-based staff, and community outreach programs. All course activities are directly tied to each teacher's individual teaching assignment. This course is a fundamental shift from prior course work for the teachers as they transition to their roles as leaders in their communities. Based on the experiences of the mathematics education professor who teaches this course, teachers in this course exhibit the same level of excitement that preservice teachers exhibit when they teach their first lessons in the field.

With this in mind, Practicum II serves as a "field placement" experience for mathematics teacher leaders. The course is an opportunity for teachers to demonstrate proficiency with the SEMS in the products they develop and through their work in the school environment. A major outcome of the course is a digital portfolio that directly aligns with the SEMS. Teachers select artifacts from each of their WOU-EMIL courses to demonstrate the proficiency they have developed with the SEMS throughout the program. At least one artifact from every course must be included. The portfolio must include a reflective statement to introduce and explain the inclusion of each artifact. Through this portfolio teachers demonstrate competency of the SEMS for the State of Oregon's EMIL specialization.

The second component in this course is a practicum observation of the teacher in the field engaged in a leadership activity. The activity can take several different forms including mentoring an individual teacher, facilitating a professional learning

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**Table 2**
Scoring Guide Indicators for Learner Development.

| 1. Learner Development<br>The leader understands how learners grow and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences. | | | | |
|---|---|---|---|---|
| Indicator | Does Not Meet Standard (DNM) | Developing Proficiency Toward Standard (DP) | Proficient Relative to Standard (PR) | Exceeds Standard (E) |
| 1.1 Demonstrates an understanding of how teachers learn and develop. | Demonstrates minimal knowledge of teacher patterns of learning and development. | Demonstrates basic knowledge of teacher patterns of learning and development. | Demonstrates thorough knowledge of teacher patterns of learning and development. | Is a resource for colleagues in understanding and interpreting student patterns of learning and development. |
| 1.2 Designs and implements developmentally appropriate instruction. | Implements activities and assignments that are not developmentally appropriate for teachers. | Implements some activities and assignments that are developmentally appropriate for teachers. | Implements activities and assignments that are developmentally appropriate for teachers. | Implements activities and assignments that challenge each teacher at his/her developmental level. |

community, or developing and implementing a professional development workshop. The specific activity is dependent on the teacher's current job description. The first teachers who completed the WOU-EMIL program lived reasonably close to the university, so instructors were able to complete observations in person. However, teachers in the current courses live all over the state. Future observations will take place using a video taken of the teacher implementing the task or through live streaming of the event. The practicum observation is scored using a rubric that is a modified form of the Western Oregon University preservice teacher observation form. The wording was changed to reflect the fact that adult learners involved in professional development are the focus of the practicum activity instead of children being taught by a preservice teacher. The WOU-EMIL practicum observation instrument has eight dimensions:

1. Learner Development
2. Learning Environments
3. Content Knowledge
4. Assessment
5. Planning for Instruction
6. Instructional Strategies
7. Professional Learning and Ethical Practice
8. Leadership and Collaboration

During the observation, leaders are rated using a 4-item scale ranging from Does Not Meet Standard to Exceeds Standard for each of the eight dimensions. Table 2 is a sample of the scoring guide for the Learner Development dimension.

## 6. Reflections, challenges, and lessons learned

Sixteen students have completed the WOU-EMIL specialization program and we estimate that approximately 50 more will complete the program by Fall 2017. As we have refined the course offerings as well as other aspects of the program, we have based some program improvements on feedback from participants. In spring 2016, we administered a short, online, open-ended survey to all of the grant-funded teachers enrolled in the program. We asked:

On average how many hours do you spend per week on coursework?

1. Do you feel that your background work in mathematics adequately prepared you for the coursework in the EMIL program?
2. Were there aspects of specific courses or types of assignments that you found particularly useful? Please explain.
3. Were there any aspects of certain courses you did not find useful or you think could use some modifications? Please explain.
4. Do you have any comments about the online aspect of the coursework? What works well? What does not work well?
5. Please provide any additional comments.

Thirty-one participants completed (60%) the survey. We recognize that these types of surveys have constraints. However, we found the participant responses are thoughtful and provide insightful information on the WOU-EMIL program. In addition

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to our own reflections on the courses, we feel participants have given us useful information on how to improve the program. In the sections below, we summarize what we have learned about the program so far and cite participant feedback when appropriate to illustrate our thinking.

### 6.1. Grant funded projects

Funding from the DEMILO grant has been critical in developing the resources necessary to design and deliver the courses in the WOU-EMIL program in an online format. We have run classes each term with participants enrolled with grant funding and supplemented with non-grant funded teachers to achieve a full cohort. The grant has also provided funds for release time and professional development for the instructors as well. By having a large number of teachers complete the program together, the WOU-EMIL program developers have received useful participant feedback which has helped to inform instructors as they make revisions to the courses. As the teachers have progressed through the program, it has been a pleasure for the instructors to witness growth and shifts in participants' mindsets – not only in their mathematics work, but also in their peer mentoring skills. Many teachers who have completed the program have taken formal and informal leadership roles in their schools and districts. The grant has provided the opportunity for continuous evaluation that has led to program refinements and improvements as well as the opportunity to understand the impact that the emerging teacher leaders are having in their school buildings. We have learned that outside funding is critical when developing capacity (Malen et al., 2015). Faculty need to time to develop coursework and teachers need an incentive to enroll in classes. Word about the WOU-EMIL program has spread and we are now seeing new teachers enroll based on recommendations of our grant participants.

### 6.2. Starting with mathematics

Based on an analysis of preliminary survey data, we note the challenges that are inherent in implementing this type of program. We are committed to the notion that all teachers must have a rigorous preparation in the mathematics content needed to teach elementary school (Ball et al., 2008). The five graduate mathematics courses provide this important foundation for future teacher leaders. However, course developers and instructors struggle with the appropriate level of difficulty for all course work. Analysis of survey data indicated that 50% of the participants felt they were not adequately prepared mathematically for the content presented in one or more of the mathematics courses. In the first year, ten of the DEMILO grant-funded participants (17%) dropped out of the program citing difficulty with the courses or the inability to balance the course work with job responsibilities and a busy family life. In open-ended comments, 20% of survey respondents either noted that the mathematics content was not helpful or cited it as a drawback to the program. One participant commented, "I do not feel like I was prepared for the courses that were math focused. They have been extremely challenging. . ..It got to the point that I stopped asking for help because I felt like I was incompetent every time I reached out for help."

In contrast, 33% of survey respondents stated that the mathematics coursework was a beneficial aspect of the program. One participant noted, "I'm just enjoying gaining new knowledge, and working with math, so even if something is not used in my elementary school classroom, I find it useful." Program developers and instructors continue to reflect on whether the drop rate indicates sufficient rigor or whether it is a sign of unreasonable expectations. Or perhaps, as suggested by Diaz (2002), dropping the course was just the "right thing to do" for teachers at a particular time in their lives because they recognized that they did not have the time to manage an academically rigorous course along with their other commitments. In fact, comments from the teachers seem to suggest the latter. *We have learned* that an interest in leadership does not necessarily indicate strong content knowledge on the part of participants. The right balance between content and pedagogy needs to be found so that teachers are able to meet the SEMS without the courses becoming inaccessible for elementary school teachers. There are specific ways that content courses for mathematics teacher leaders can be structured in order to develop the specialized mathematics needed for teaching and we have consciously tried to attend to those ideas in our course design (Whitenack, & Ellington, 2013).

### 6.3. Managing expectations

Some of the teachers who have participated in the program have had misconceptions about expectations – what they expected from the program and what was expected of them. Teachers reported they spent on average 13.87 h per week completing course work with a minimum of 3–5 h per week and a maximum of 20–35 h per week reported. The stated expectation is that participants should plan for 9–12 h of work per week. For many, this workload is difficult to maintain with full time teaching jobs and family obligations.

Some teachers joined the program because they wanted to brush up on their mathematics skills, but they did not anticipate an in-depth study of the mathematics covered at grade levels beyond the grade they teach. Other teachers expected the courses to be short professional development experiences rather than graduate level coursework. There were teachers who, while seeming to understand that the courses are intended to prepare K – 8 leaders, still reported they felt that mathematics at a level "outside of what they teach" is not important for them to know and understand. Many who held these views dropped the program. In fact, we have found that as the teachers progress through the program, their views seem to shift to a better appreciation of the depth and breadth of the content they are learning and the skills they are developing. One of

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our first WOU-EMIL program graduates, who is also earning her MSED-EMIL degree, described her understanding of what the program prepared her to do as,

> "Elementary Mathematics Specialists are the backbone of a school's mathematics program and a leader (sic) to all within the community. Students, teachers, administrators, and the community can come to the Elementary Mathematics Specialist and ask questions, gain understanding and knowledge about mathematics, and partake in mathematical activities designed and implemented by the Elementary Mathematics Specialist."

Based on our experiences with providing professional development programs for teachers, we have found classroom teachers want to be presented with ideas and techniques they can take back to their classrooms and use right away. The survey data supported this perception, as 40% of survey responders found that the assignments most closely tied to their teaching assignments to be the most helpful components of the program. Furthermore, 13% specifically stated that when assignments did not make direct connections to their teaching assignments, they found the assignments to be less useful. We realize that by offering the mathematics courses before the leadership courses, we are not satisfying the desires of the participants. However, since the mathematics courses are closely aligned to the CCSSM, the concepts in the mathematics tasks throughout these courses are clearly usable with children. In addition, the courses require teachers to think deeply about the mathematics and develop a conceptual understanding that is beyond a purely algorithmic point of view. A few teachers have shared that, while the education courses require a similar workload to the mathematics courses, they appreciate that the assignments in the education courses are directly tied to the classroom. One teacher wrote, 'I think [Advanced Content Pedagogy: Mathematics] has provided some of the most beneficial assignments because they are contextualized and fully relevant.' *We have learned* that teachers have strong preconceptions and motivations when choosing professional development experiences (Masuda, Ebersole, & Barrett, 2012). Grant funding also entices reluctant learners to participate since coursework can be offered for free or at a reduced cost.

### 6.4. Effective strategies

We have found having candid conversations with teachers before they enter the program has been very helpful in managing their expectations. Some instructors have found having a one-time online meeting through voice-screen sharing tools at the beginning of the term to introduce themselves and talk about the particulars of the course is an effective means for setting a tone in which teachers feel supported and connected to the program. For example, one teacher noted that, "Videos made by the instructor using a PowerPoint to explain and show the key concepts and competencies for the course [were especially helpful in understanding the course content]."

Building a sense of community is important especially in online courses where teachers can often feel isolated (Swan, 2002). Every course has multiple discussion forum assignments where teachers interact with each other. They also interact in through required team assignments. Often discussions are very rich because the asynchronous nature of the online forum gives teachers time to reflect before writing thoughtful responses to one another. Survey participants indicate mixed feelings regarding group work. Around 17% listed group projects a positive aspect of the courses, while 20% listed it as a negative aspect. We continue to explore ways to build a community in the courses, while incorporating group work in an authentic way.

Instructors find ways to inject themselves into the course in meaningful ways by, for example, having a strong online presence or by being available for help through many different formats (i.e. help forums, chats, emails, phone calls, or video calls) and at times outside the normal workday (i.e. late afternoon, evenings, or weekends) to accommodate the schedules of working teachers. The teachers in the WOU-EMIL program indicate they feel the instructors are proactive about helping teachers and are responsive to their needs. Surveys of the leaders-in-training confirm they benefit from the consistent instructional style presented across the modules and courses. They have also shared they value the clear, well-defined assignment rubrics used in every program course. They value rubrics because they distinguish between different levels of student work and provide sufficient details for each category so that the teachers know what is expected of them on the course assignments. Twenty-seven percent of survey respondents stated that both the instructor and the course structure were positive aspects of the program. One survey participant said, "The EMIL courses have been awesome. The instructors do great at giving feedback in a more timely manner than some of my other Masters' (sic) coursework classes." We have learned that there are challenges that come with online course offerings, but there are ways to address these challenges (Seung-won Yoon, 2003). Instructors who teach courses for the WOU-EMIL program must be committed to developing their online teaching pedagogy and responding to the needs of learning participating through distance education. While it is difficult to teach online, we know that many of our participants lack access to a regional university and this instructional format is the best approach for our geographical region.

### 6.5. Next steps

WOU students have now become the first Elementary Mathematics Instructional Leaders in the state. Naturally, we are thinking about where these teachers are able to put their leadership skills into practice. Some teachers work in schools with limited resources and small student populations which makes it difficult to justify a full time mathematics coach. How do

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we best advocate for schools to capitalize on the knowledge of these new leaders? Is there a model for their new role that works for small, rural schools?

In addition to their roles in schools, we are excited to see how the new leaders are contributing to the profession. In particular, we are working with six teachers to publish their course assignments in the regional mathematics teacher journal and one teacher has been published already. A small group will also make a presentation at the regional mathematics teacher conference in a strand specifically structured for mathematics teacher leaders to share their work. Finally, we hope some graduates will be interested in teaching at WOU as adjunct faculty in our preservice teacher licensure program.

The WOU-EMIL program developers are exploring ways to market our program to teachers in districts across the state. As the grant winds down, we will need to meet enrollment requirements with non-grant funded practicing teachers. One teacher shared with us that she was,

> ". . .so glad that this program exists and that I'm able to be a part of it! I really feel like the characteristics of the work that we are doing is the type of work that we should be doing in our buildings with our colleagues, but instead our professional development days are filled with meetings about a variety of things that don't necessarily equip us to be better, more informed teacher(sic)."

And teachers are signing up based on word of mouth. In fact, in the past six months, three teachers have enrolled in the WOU-EMIL specialization program based on a recommendation of their colleague who is a current participant. Our state has a long history of educating reading specialists, but we are working to elevate mathematics teacher leaders to the same level as reading specialists. WOU-EMIL graduates who work as mathematics teacher leaders are an important examples of the value of our program to the profession.

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