

PROVIDING REAL-WORLD EXPERIENCES: THE VIRGINIA TECH EXTERNSHIP FOR MATHEMATICS SPECIALISTS

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Abstract

We describe the structure and implementation of the yearlong Externship experience associated with the Mathematics Specialist program at Virginia Polytechnic Institute & State University (Virginia Tech). We discuss the assignments and experiences included in the Externship, the alignment of those experiences with the job description developed by the Virginia Mathematics and Science Coalition Task Force, and teacher comments on the effectiveness of their Externship experiences [1].

Introduction

The Mathematics Specialist program at Virginia Polytechnic Institute & State University (Virginia Tech) is a three-year master's degree program designed to provide a cohort of practicing teachers with the content, curriculum, leadership, and assessment courses required for certification and licensure as a K-8 Mathematics Specialist in Virginia. During the third year of this program, teachers are engaged in a yearlong externship experience. This Externship was designed as a capstone experience for teachers to provide practical experience associated with being a school-based Mathematics Specialist within the teacher's home school setting. The recommendations and final report from the Virginia Mathematics and Science Coalition Task Force served as the framework during the design process for this Externship [1]. The specific requirements for the Externship during the fall and spring semesters are presented in Table 1. Each of the specific requirements within the Externship was chosen to align closely with the roles and responsibilities set forth in the Task Force recommendations [1].

Table 1
Requirements of Externship

REQUIREMENT	DESCRIPTION
FALL SEMESTER	
needs assessment	This report included an outline of the mathematics teaching and learning needs of the school and how they relate to the project to be conducted for the Spring, a review of literature related to the chosen project, project implementation plan, and expected outcomes (personal and school-based)
principal meetings	As part of the needs assessment, teachers were to meet with their principals during the yearlong Externship to discuss needs and issues.
grade-level meetings	As part of the needs assessment, teachers were required to meet with each grade level to discuss hopes and needs for math.
lead a faculty or department meeting related to math	As part of the needs assessment, teachers were to take on a leadership role in a faculty or department meeting based on discussions with the principal.
contribute to the implementation of a district-wide initiative	The cohort was required to develop a professional development experience for all teachers in the district related to the <i>Enhanced Scope and Sequence Plus</i> document.
thought papers/ reflection	Throughout the semester classes, teachers responded to writing prompts designed to have them reflect on different aspects of the needs assessment process and experiences.
activity log/time log	Teachers were required to keep a log listing the types of activities engaged in as a Mathematics Specialist and the approximate time associated with each activity.
SPRING SEMESTER	
final project	Based on the needs assessment, each teacher was required to conduct a final school-based project to address the determined need. This initiative was to represent a systemic program—be more than a “one-shot” initiative.
report of final project	This report included the background literature review for the chosen project, rationale for the project, needs assessment, implementation plan, anticipated outcomes or research questions,

	methodologies/procedures, findings/outcomes, an overall discussion of the project, its impact and implications for future plans.
presentation of final project	Teachers were to present a 20-30 minute presentation of the chosen project—background literature, needs assessment, rationale for project, plan implementation, results, evaluation of the project, and implications for the findings of the project.
activity log/time log	Teachers were required to keep a log listing the types of activities engaged in as a Mathematics Specialist and the approximate time associated with each activity.
thought papers/ reflections	Throughout the semester, teachers responded to writing prompts designed to have them reflect on different aspects of the needs assessment process and experiences.

Experiences Prior to and Concurrent with the Externship

The seventeen teachers that were involved in the initial Externship experience were in their third and final year of the Mathematics Specialist program at Virginia Tech. Fourteen of the participants were teachers from a local school district and three were acting Mathematics Specialists within a city school district. Prior to the Externship, the teachers had completed five mathematics content courses, as well as two courses entitled *Assessment in Mathematics* and *Mathematics Education Leadership I*. Through the leadership course, the teachers learned about content area coaching and mentoring, and each was involved in the full coaching process (interview, pre-conference sessions, lessons, and post-conference sessions) with both a new teacher and a veteran teacher at each of their schools [2]. At the beginning of *Leadership I*, the principal of each teacher was visited by university faculty to discuss and describe the structure and expectations for that course.

Concurrent with the yearlong Externship, the teachers were enrolled in the fall in a course entitled *Advanced Curriculum and Instruction in Elementary and Middle School Mathematics*, in which they were involved in conducting a formal lesson study with a group of their peers in their home schools. As part of this course, teachers were also required to present a session (individually or in a small group) at the local annual conference of the Blue Ridge Council of Teachers of Mathematics. In the spring, they were concurrently enrolled in *Mathematics Education Leadership II*. These prior and concurrent experiences set the stage and prepared these teachers for the requirements of the Externship.

Externship Components: Needs Assessment

The general goal of the yearlong Externship was to have the teachers conduct needs assessments in the early fall of the mathematics teaching and learning in the teachers' home schools through interviews, discussions, and observations. The needs assessments provided the groundwork and framework for the implementation of a school-based initiative during the late fall and spring which served as the culminating experience for the teachers and their final master's degree projects. By working within the teachers' home schools, the support of the principals and faculty colleagues enabled the teachers to work through this entire process in a safe and supportive environment.

Externship Components: Principal Meetings

The principals of program teachers and the district mathematics supervisors for the three Mathematics Specialists were visited by a Virginia Tech mathematics education faculty member to discuss the design of the Externship requirements and experiences. These meetings occurred before the teachers began the needs assessment process. During the Externship, the teachers interviewed the principals concerning their work and to determine the principals' vision concerning Mathematics Specialists, the mathematical needs within the school building, and concerns or issues that the principals wanted addressed through the Externship process. These meetings not only engaged the principals in the needs assessment process, but also kept the principals connected to the school-based project and helped initiate principal support for the teachers.

Externship Components: Grade-Level Meetings

As a part of the needs assessment, each teacher met with each grade level within their school (and in effect met with all teachers in the building) to discuss hopes and needs for mathematics in the building. These meetings required teachers to take on a leadership role in facilitating these discussions which were focused on specific school-based and grade-level mathematical needs. During these meetings, discussions tended to center on, for example, *SOL* data, classroom data, classroom issues and problems, perceived gaps in students' *mathematical* understanding, and math content with which students struggled.

Externship Components: Faculty or Department Meeting

As part of the Externship, teachers were required to lead a faculty or department meeting. Through this experience, teachers were able to take on more of a school-based leadership role,

leading a schoolwide discussion of the mathematical needs within the building. These meetings allowed for schoolwide discussions across all grade levels. Therefore, these discussions tended to focus on overall school concerns about mathematics, such as vertical alignment of concepts, schoolwide problem areas as evidenced in overall school *SOL* data, and weaknesses of students from one grade to the next.

Districtwide Initiative

The one shared experience for all teachers in the cohort was designed to provide teachers with the experience of working with a school district initiative. All of the teachers in the cohort were trained on the *Enhanced Scope and Sequence Plus* document [3]. They were then required to plan and provide professional development opportunities for fellow teachers on the appropriate applications and usefulness of this resource. The teachers could work individually or in small groups to design and present this professional development activity to school faculty groups.

Reflections and Class Meetings

Throughout the yearlong Externship experience, eight class meetings were scheduled. During these meetings, activities were designed to support and guide the teachers through this shared experience. Teachers were given very specific writing prompts (see Table 2) to have them reflect on the ongoing needs assessment process and other school-based experiences. These prompts allowed the teachers to reflect on and then share their experiences, issues, and concerns. This mutual sharing provided support for the teachers as they discussed generalities together and brainstormed strategies for dealing with issues or concerns. Even though the nature of each teacher's individual investigation depended on the structure and needs of each individual school, they could share and support each other throughout the process.

Table 2
Writing Prompts

DATE	WRITING PROMPT
SEPT	What are your expectations of the Externship?
OCT	Do you feel prepared for the Mathematics Specialist position? If yes, why? If no, what do you feel you still need to know?
DEC	Reflect on what you have learned about yourself as a Mathematics Specialist through the needs assessment process for your school.
FEB	<p>Have you begun the implementation of your project? If yes, describe one thing that you have done as a part of the implementation and briefly discuss strengths/weaknesses, successes/"wish I had done differently". If no, describe what you plan to do first.</p> <p>As you begin the implementation of your project, discuss your attitudes toward working with students, teachers, or parents, etc. as a "Mathematics Specialist."</p>
MAY	Reflecting on your Externship experience this year, list and discuss two aspects of the Externship that you feel have had the greatest impact on your beliefs about your ability to be a successful Mathematics Specialist. Discuss one thing that you feel would have enhanced your Externship experience and ultimately would have better enhanced your potential to be a successful Mathematics Specialist.

Externship Components: Activity Log/Time Log

Throughout the activities surrounding the needs assessments, teachers kept activity/time logs, documenting all types of activities related to being a Mathematics Specialist in their schools during the year and the amount of time associated with each activity. Once these teachers began the schoolwide needs assessment process, they noticed a shift in their status with other school personnel. Although they were not officially Mathematics Specialists, the role of the teachers informally shifted from classroom teacher to that of a building-level Mathematics Specialist. The principals, fellow faculty, and staff began to treat many of the teachers as Mathematics Specialists; for example, they asked content questions, assessment questions, and sought advice on instructional strategies. Through this documentation process, the teachers could capture these changes in their roles.

Externship Components: Final Project

Based on the needs assessment, each teacher conducted a final school-based project intended to address one of the identified school-based needs in the area of mathematics. This project was to be a systemic program—not a “one-shot” initiative—consisting of a series of meetings, workshops, or instructional sessions that was documented and evaluated over the course of the Externship. Once the specific need was identified, each teacher conducted a literature review to determine appropriate ways to address the determined need. From this research, teachers were able to gain research-based support for the design and structure of their initiative.

Specific projects resulted from the individual needs assessments conducted by the teachers (see Table 3). In three instances, multiple teachers were faculty at the same school so they held the meetings and discussions within the needs assessment process together. In these cases, individual teachers performed individual reviews of the literature and then a joint decision was made as to the most appropriate project for the school. Each individual teacher carried out the implementation of the chosen project. During the implementation of the initiative, teachers were visited and observed by Virginia Tech mathematics education faculty.

Table 3
Title and Description of Teacher Final Projects

<p>Vertical Alignment Through Communication -designed, initiated, and facilitated cross grade-level meetings to discuss <i>SOL</i> requirements, instructional strategies, manipulatives used, and math concepts taught</p>
<p>Using Assessment to Plan Instruction -facilitated collaboration between all grade 2 teachers to implement use of exit slips, anecdotal teacher comments, and other assessment strategies to determine placement of all grade 2 students into groups (remediation, extra practice, and enrichment); used parent volunteers and literacy volunteers to focus students on the created activities designed to meet the needs of each of these groups</p>
<p>Measuring the Alignment of Instructional Delivery in Computation -designed and facilitated a meeting involving all the faculty across two schools (a primary school that feeds into an elementary school) to focus discussions between all grade-level teachers on instructional strategies, vocabulary, algorithms, and manipulatives that currently are being used to teach computation</p>
<p>Parent Nights -designed and implemented parent nights to teach parents the alternative algorithms of partial sums, partial products, and lattice multiplication</p>

<p>Leap into Learning</p> <ul style="list-style-type: none"> -used data to select small groups of students (upper elementary) to attend 18 before school remediation sessions scheduled over 18 weeks -designed curriculum materials and taught the sessions -focused on vocabulary around operations
<p>Building Computational Fluency</p> <ul style="list-style-type: none"> -created and presented a whole-faculty staff development workshop on computational mastery -planned and facilitated Math Mondays, a tutoring session for struggling students using Virginia Tech tutors and math games -focused Learning Lunches on math issues, presented workshop for parent volunteers -coordinated efforts of retired teachers acting as tutors at local trailer parks (created binders of math materials and presented staff development for the tutors)
<p>Manipulative Project</p> <ul style="list-style-type: none"> -surveyed teachers and presented mini-professional development sessions on the topics of fractions, operations, and number sense -designed and presented whole school staff development on manipulative use -compiled a school-wide listing of all manipulatives
<p>Building Computation and Estimation Skills Using Games, Manipulatives, and Songs</p> <ul style="list-style-type: none"> -assisted SOL remediation tutor to identify students using SOL data -designed and led whole-faculty meeting on <i>SOL</i> data results for school to identify areas of concern -planned and facilitated workshop “Fun with Fractions” -facilitated whole school implementation of the use of multiplication fact songs
<p>Building a Mathematical Community One Lesson Study at a Time</p> <ul style="list-style-type: none"> -created, administered, and analyzed faculty survey on areas of concern -used results to choose topic to use for Lesson Study format within two different grade levels (plan lesson, teach, reflect)
<p>From Summative to Formative Data</p> <ul style="list-style-type: none"> -worked with school math teachers to interpret state assessments -facilitated discussions with faculty on the use of formative assessment strategies -assisted teachers in implementing formative assessments (exit slips, observation check lists, reflections, student self-evaluations, student interviews)
<p>The Math Toolbox Program</p> <ul style="list-style-type: none"> -applied and received grant and using these funds purchased manipulatives (cuissenaire rods, rulers, base 10 blocks, and <i>Everyday Math</i> card decks) to create parent kits -designed and presented 5 parent night sessions (games, cuisenaire rods, base-ten blocks, time and money, Achievement Record process) and gave all participating parents a math toolkit
<p>Understanding Math Plus (districtwide software package)</p> <ul style="list-style-type: none"> - designed evaluation process of the software package and use based on funding costs
<p>Teachers + Fractions + Manipulatives = Understanding</p> <ul style="list-style-type: none"> -designed and facilitated 3 sessions of professional development for districtwide faculty -created binder for presentation and to give to participating teachers -observed participating teachers for manipulative use as follow-up to sessions

Externship Components: Final Report

The teachers were required to produce a final report discussing the following topics: 1) the needs assessment; 2) the background literature supporting the final project; 3) the project's implementation plan, anticipated outcomes or research questions, methodologies/procedures, findings/outcomes; 4) overall discussion of the project; and, 5) future plans based on the outcome of the project. The process of writing a final report provided teachers with an authentic experience that would relate to the role of a school-based Mathematics Specialist: i.e., reporting to stakeholders about a school need, the implementation of an initiative to address the need, and the effectiveness of the plan.

Externship Components: Presentation of Final Project

Each teacher was required to deliver a twenty to thirty minute presentation to the cohort and to selected Virginia Tech mathematics and mathematics education faculty. This presentation addressed the background literature, needs assessment, and rationale for the chosen project. The presentation was designed to give each teacher the opportunity to discuss what was done and the results of the project, an evaluation of the project, and the implications for the findings of the project. Similar to the final report, the presentation provided teachers with the experience of communicating the results of a school-based initiative. These presentations also allowed the other teachers in the cohort to experience and follow the process of other needs assessments and initiatives in different school settings with different faculties and different sets of mathematical needs.

Reflections on Externship: Effectiveness

We feel that the Externship's close alignment with the real-world experiences that would be expected in the role of a Mathematics Specialist greatly contributed to the overall effectiveness of the experience. A school-based Mathematics Specialist must collaborate with the principal and teachers to analyze the mathematical needs of the building through interviews and discussions with different groups of teachers, as well as the whole faculty. The required needs assessment provided a structure through which this could happen during the Externship. This structure further ensured that these teachers were engaged in a systematic process of identifying a school need and conducting a review of the literature to determine an appropriate means for addressing the need. Each teacher worked within a unique school setting to determine needs and, therefore, the individual teachers were required to address very real and specific needs as they existed within each specific school.

The continuation of scheduled class meetings throughout the Externship provided support for the teachers as they developed and carried out their individual projects. This support came through opportunities for reflection and discussion with the rest of the teachers in the cohort and the university mentors. This provided a “safety net” for these teachers as they stepped from the classrooms into schoolwide leadership positions.

Reflections on Externship: Strengths

Several aspects of the process emerged as real strengths of the designed Externship experience. One of the major strengths of the experience was that each teacher was immersed in the mathematical needs of one school. They were further required to conduct a review of the research literature to determine an appropriate plan and implementation process to address the identified needs. This individualization and close tailoring of the project to a school’s need brought realism to the entire process—the needs were determined by the stakeholders within each school and the school’s specific need was addressed. Another strength of the Externship was the support it provided for these teachers through continued class meetings. These meetings provided teachers with a safe environment in which to talk through issues and concerns related to their project with cohort members, as well as gain valuable insight from discussions in small and large groups.

During *Mathematics Education Leadership I*, a university faculty member met with each school principal to discuss the coaching process in which the teachers would be involved. This contact was reestablished at the beginning of the Externship with an additional meeting with the principal to discuss the expectations of teachers during the Externship. These contacts made it possible for a strong collaboration between the university and the school, ensuring that the principals felt a strong part of the entire needs assessment process and that the teachers had principal support during these experiences. Principals and other faculty provided additional support for these teachers as a result of the needs assessment and resulting project being so closely aligned with authentic school needs.

Concluding Teacher Comments on Externship Experiences

At the conclusion of the Externship, the teachers were interviewed individually. In response to the final question within the interview protocol, “Is there anything that you gained from the Externship experience that you feel you did not get in any of the other courses in the master’s degree program?” teachers had the following comments:

- “The Externship is a must. I think if we didn’t have that, you almost deprive teachers of the experiences. I think for me the light bulb may not have really come on about what this really is until I was really engaged in it.”
- “You don’t get that experience out working in the school until you are there. You can talk about it in the classroom all you want, but I don’t think you actually understand it until you get out there and work and experience it, like we [did]. We actually had to be a Mathematics Specialist and do those jobs. I think that is when you learn the most.”
- “To integrate it all into realistic classroom settings in the school itself and to work with the teachers and the kids made it more meaningful and made it more realistic and more integrated. It made that wholeness to it and that was what I was hoping for, putting all the pieces together.”
- “It is one thing to talk about and learn about it in your own class, it is another to have to put yourself out to your grade level or to a department or whatever, and another level to do something for a whole school situation. I really think that the Externship has got to be a critical component of the program. There is no way that you can get that kind of experience inside a classroom no matter how good your instructors are. That hands-on experience is so much more valuable than just being told how to go out and do it.”
- “You can read about stuff, but if you don’t do it, you don’t really learn it. I learned that I knew more than I thought I did which has helped, but I also learned that everyone doesn’t know as much as I assumed they do. That was a bigger eyeopener and [something] you cannot learn in a book.”
- “It is the hands-on experience: you can tell me, but until I get out there and do it myself, I am not going to know exactly how it works or exactly what it is supposed to look like. You can’t just sit and listen about it.”

These responses capture the teachers’ feelings about the importance of having time set aside in which to apply the skills and concepts learned. Twelve of the seventeen teachers specifically mentioned the value of being able to apply what they had learned throughout the program during this Externship experience. Based on the comments of these prospective Mathematics

Specialists, it is evident that their experience within the Externship was very beneficial, and provided the opportunity to authentically practice their new roles in a safe and supportive manner.

References

- [1] “Mathematics Specialist Task Force Report,” Virginia Mathematics and Science Coalition Task Force, *The Journal of Mathematics and Science: Collaborative Explorations*, **8** (2005) 5-22.
- [2] L. West and F.C. Staub, *Content-Focused Coaching: Transforming Mathematics Lessons*, Heinemann, Portsmouth, NH, 2003.
- [3] *SOL Enhanced Scope and Sequence Plus*, Virginia Department of Education Training and Technical Assistance Center; Internet: <http://www.ttaonline.org/staff/sol/sol.asp>.