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Exploring Elementary Content Specialization: Benefits and Cautions, Pitfalls and Fixes

Kimberly A. Markworth, Ph.D., *Western Washington University*
Joe Brobst, Ed.D., *Old Dominion University*
Ruth Parker, Ph.D., *Mathematics Education Collaborative*
Chris Ohana, Ph.D., *Western Washington University*

Abstract

Teaching elementary mathematics well is a significant challenge for self-contained classroom teachers who are responsible for teaching all content areas. This article reports on research findings regarding elementary content specialization (ECS), in which elementary teachers share classes of students in order to specialize in certain content areas, oftentimes manifested through a team teaching model. The research findings from this study relate to four takeaways: focus, professional development, instructional time, and student support. In addition, potential pitfalls and corresponding fixes with implementing ECS are identified and discussed. Teachers, specialists, and administrators considering ECS through team teaching may use these results, takeaways, and recommendations to weigh the benefits and challenges of ECS, as well as plan for best practice and potential pitfalls.

It is easy to argue that the tasks and challenges of teaching elementary mathematics have changed over the past three decades. Building on the ground-breaking standards movement begun in the 1980's, *Principles to Actions* identifies eight effective mathematics teaching practices:

- Establish mathematics goals to focus learning.
- Implement tasks that promote reasoning and problem solving.
- Use and connect mathematical representations.
- Facilitate meaningful mathematics discourse.
- Pose purposeful questions.
- Build procedural fluency from conceptual understanding.
- Support productive struggle in learning mathematics.
- Elicit and use evidence of student thinking. (National Council of Teachers of Mathematics, 2014, p. 10)

These practices present arduous demands for teachers and their instruction. When coupled with rigorous standards for students and the expectation that educators engage *all* students as learners of mathematics, the challenge of being an effective mathematics teacher becomes one that requires strong content and pedagogical content knowledge, ongoing professional development, and reflective inquiry.

Traditionally, elementary teachers are expected to be generalists, required to teach all content areas to their students in a self-contained classroom setting. An elementary teacher is expected not only to rise to the expectations of teaching mathematics well, but also to similar expectations in the other content areas. These changing expectations for elementary teachers in all content areas may be making self-contained models of instruction difficult to sustain.

Team teaching in the elementary grades is not a new concept, and elementary teachers are likely already familiar with some of the varied arrangements of team teaching that are possible. In some locations, these arrangements are ubiquitous – a school-wide arrangement for some grade levels with its own tradition and the kinks already worked out. For example, in the fifth grade where I started my classroom teaching, teams of three classroom teachers would share students. I taught science to three classes and mathematics to two classes while the other two team teachers shared responsibility for language arts and social studies. (For descriptions of various team teaching models, see Markworth, Brobst, Ohana, & Parker, 2016, or Markworth, 2017.)

In other schools, the determination to maintain the traditional self-contained classroom structure is strong. Resistance to alternatives may be grounded in concern for the developmental appropriateness of elementary students receiving their instruction in a structure that resembles those used with older students. Or, teachers may be so used to self-contained instruction that consideration of a different structure has never been given much thought.

Several educators have argued for the increased implementation of content specialization at the elementary level by citing potential advantages (Chan & Jarman, 2004; Gerretson, Bosnick, & Schofield, 2008; Reys & Fennell, 2003; Wu, 2009). With teachers focusing on specific content areas, they can have additional time to develop cohesive and meaningful lesson plans around a subject. Professional development can target specific content areas and the instructional practices that will support students' learning. Teachers can teach subjects that they are both enthusiastic about and feel competent to teach. Potential advantages for students include increased access to expert instruction and the ability to benefit from multiple teachers' teaching styles.

In our NSF-funded research project, *Every Day Every Child*, we examined local cases of Elementary Mathematics Specialists (EMS) as full-time teachers of two or more classes of students for mathematics in order to:

- characterize different specialist instructional models (see Markworth, Brobst, Ohana, & Parker, 2016, or Markworth, 2017), and
- provide evidence regarding the impacts of these alternatives to self-contained classrooms on teachers and students (discussed here and in Markworth, Brobst, Ohana, & Parker, 2016).

The practice-based goal of this paper is to communicate practical generalizations from our research – benefits and cautions, pitfalls and fixes – to inform teacher and administrators' decisions regarding the use of EMS as full-time classroom teachers in a non-self-contained setting.

Methods

Participants

We use the term *EMS teachers* henceforth to distinguish these classroom teachers from EMS who serve as coaches and/or interventionists, as identified by McGatha and Rigelman (2017). All of the EMS teacher participants in this research (n=24) taught either 2 or 3 classes of students in mathematics. Nine (9) of the EMS teachers specialized only in mathematics; the rest of the EMS teachers (15) specialized in additional subject areas such as Reading, Writing, Science, and Social Studies. Of the 24 EMS teacher participants, 1 teacher taught 1st grade, 3 teachers taught 3rd grade, 8 teachers taught 4th grade, 10 teachers taught 5th grade, and 2 teachers taught multiple grades.

A comparison group of teachers consisting of self-contained elementary teachers was recruited first by identifying schools with similar demographic and socio-economic student populations and then by identifying self-contained teachers within those schools with a similar number of years of experience to EMS teacher participants. The resulting comparison group (n=17) was comparable in age and years of experience. Differences in the number of teacher participants in each group related to attrition over the course of the two-year data collection process and changes to teacher assignments. Additional information regarding the selection and comparison of participants can be found in Markworth, Brobst, Ohana, & Parker, 2016.

Data Collection and Analysis

Our project team of two mathematics educators and two science educators conducted semi-structured interviews, online teacher surveys, and six video-recorded classroom observations per participating teacher. For the EMS teacher participants, these were conducted over an 18-month time span; the comparison group of teachers, which was recruited in the second year of the project, completed these tasks during a single academic year.

Interviews. Each participant took part in an interview using a semi-structured interview protocol. When there were multiple teacher participants at the same school, they were invited to complete this activity in a focus group. All interviews were audio-recorded and transcribed for analysis.

Qualitative coding of all interview data was accomplished using NVivo qualitative analysis software. Initially, all interviews were coded using two lenses: a temporal lens and a stakeholder lens. Then, transcripts were coded according to a combination of *a priori* themes (e.g., collaboration, curriculum, resources, and standards) and emergent themes (e.g., flexibility, continuity, and content integration). Data from this analysis was used to identify the four takeaways and potential pitfalls discussed below, as well as to triangulate the findings from the quantitative analysis of the surveys.

Survey. Participants also completed a two-part online survey. Surveys consisted of original questions as well as questions drawn from existing instruments, primarily the 2012 National Survey of Science and Mathematics Education (Horizon Research, 2012). Questions covered a range of topics: demographics; educational and teacher preparation; teaching responsibilities; factors related to the teacher's current teaching position; factors influencing the initial impetus and continuation of the specialist model; teacher beliefs about mathematics instruction; enthusiasm and preparedness for all subject areas; and professional development experiences and needs.

Survey data was analyzed using the IBM SPSS Statistics 23 software package. First, descriptive statistics were generated. Next, comparisons between the means of EMS teachers and self-contained teachers' responses were conducted using independent sample t tests (two-tailed) along with integrated Levene's tests for equality of variances.

Classroom Observations. Each participant completed a total of six video-recorded classroom observations. These were divided into three pairs of two consecutive days. Lessons were scored by the two mathematics educators on the project using the Reformed Teacher Observation Protocol (RTOP). The two scorers established inter-rater reliability by independently scoring 11 videos and negotiating a score. This helped to clarify their scoring procedures and establish common understanding of the RTOP criteria. A linear regression between the original scores demonstrated that the R^2 value of 0.9529 met the project's expectations for inter-rater reliability and was consistent with the reported inter-rater reliability of the RTOP instrument (0.954).

The first five videos for each classroom teacher were scored by one of the mathematics educators, sharing each participant's videos between the two scorers. Next, we analyzed the spread of teachers' scores for their first five videos; the individual teachers' scores demonstrated little variance. Three teachers had greater variance than others, greater than 15% of the total possible points on the RTOP. Thus, for these three teachers, we scored their sixth videos. An independent samples t-test was performed to compare the math specialist and self-contained teachers on their total RTOP scores as well as the five sub-categories.

Additional information regarding the project's data collection and analysis of interview and survey data can be found in Markworth, Brobst, Ohana, & Parker, 2016, and Markworth, 2017. Interview protocols and teacher surveys are available at the project website https://cse.wwu.edu/smate/edec-instruments. Information about the RTOP, including its psychometric properties and a manual for training and implementation, can be found at http://www.public.asu.edu/~anton1/AssessArticles/Assessments/Biology%20Assessments/RTOP%20Reference%20Manual.pdf.

Findings

We have distilled the findings from these data collection activities and data analyses into the following takeaways for teachers and leaders who may be considering alternatives to the self-contained classroom: focus, professional development, instructional time, and student support. In the following sections, we discuss our findings and how they relate to each of these generalizations.

Takeaway 1 - Focus

The most obvious and appealing benefit to engaging in a team teaching model is likely its impact on a teacher's ability to focus on fewer content areas. Team teaching results in fewer "preps" – content areas for which the teacher needs to prepare. In a self-contained classroom, the teacher needs to be knowledgeable about and well-prepared to teach the primary content areas of mathematics, science, social studies, reading, writing, along with others such as spelling, technology, art, etc. EMS teachers, by taking on two or more classes of students for mathematics, give up one or more of these content areas, allowing them to focus their energy and time on fewer areas.

Planning Time. Elementary teachers have a set amount of planning time during their day, and all elementary teachers know that substantial planning occurs outside of these hours. EMS teachers in our study reported an average of 270 minutes planning for their mathematics instruction per week, a statistically significant difference from the average of 159 minutes per week spent by self-contained teachers. EMS teachers also demonstrated greater satisfaction with their planning time, being significantly more likely to agree with the statements, "I have enough time to plan for all of the subjects I teach," and "I have enough time to plan for my math instruction."

More time spent planning has the potential to translate to richer mathematics lessons. Amy (pseudonym), a 5th grade teacher who teaches mathematics to three classes of students, discussed a substantial impact on her instruction:

> I think it's really helpful just to be able to have more time to plan and really dig deeper into the standards…. [You] can really dig deeper and find cooler activities, more interactive activities than just doing a worksheet or something on paper…. I spend a lot more time planning…. This way all my time is focused on math and increasing student understanding. Where before it's like, "Okay. We'll do the best we can and move on."

Generally, EMS teachers did not find that fewer subject areas reduced overall planning time. Rather, they indicated that their time was better, or more deeply spent. Melia, another fifth-grade teacher, specializing in both mathematics and science, had similar thoughts:

> I think you can plan deeper lessons so it's not like I don't…if say a 45-minute planning day, I don't feel like, "Well now I only need 30 because I'm teaching the same thing twice." I'm able to take that lesson deeper. I still need the same amount of time. Does that make sense?

EMS teachers can focus their planning time on particular content areas, delving deeper into standards, rich learning experiences, and differentiation for their diverse learners.

A Mathematics Classroom. A focus on mathematics also allows teachers to create a more content-focused learning environment for students. A self-contained elementary teacher's classroom is a colorful jumble of sights and stations related to all content areas. Although this is often pleasant, it restricts teachers' ability to create a laboratory of learning in which posters of strategies and vocabulary resources linger indefinitely, mathematics manipulatives and activities remain accessible, and students' opportunities to make mathematical connections are cultivated. As Shirley stated about her experience, "I liked being able to establish my classroom as focused on math, so I had math stations up that I didn't have to take down because I needed room for something else. The whole room was a math lab." When teachers can focus on mathematics, the opportunities arise to create more cohesive and supportive learning environments for students.

Take-Away 2 – Professional Development

Content focus can also positively narrow a teacher's engagement in professional development. Instead of spreading oneself thin at professional development for all of the content areas, an EMS teacher has flexibility to pass over professional development in some content areas and extend it in mathematics. Eliza (4th grade), for example, found that professional development in mathematics and collaboration with colleagues was more warranted in this role:

> And I do think since I have started teaching a math block it has legitimized my commitment of time to in-service in the summer, to in-service PD during the school year, to my collaborative work with the rest of the grade levels in the building.

Additionally, professional development can have more substantial effects on teachers' practice. Not only can EMS teachers attend more mathematics-focused professional development, they have additional opportunities to apply and refine new learning through lesson repetitions. Consider a 5th grade teacher's reflection on trying to enhance effective teaching practices in all content areas:

> And I think the specialist model – especially for intermediate – because there's so many things that teachers have to know really deeply that making change is hard when you're trying to make change in so many different subject areas.

Professional development is more worthwhile both in what an EMS teacher can attend and the impact it can have on the teacher's instruction.

The importance of engaging in ongoing professional development for EMS teachers cannot be understated. *Every Day Every Child* conducted its research with EMS teachers who had no specific preparation in mathematics and where additional, sustained preparation was limited. Our comparison of the quality of instruction revealed that, in fact, the EMS teachers' quality of instruction was slightly lower than that of their self-contained counterparts – though this difference was not statistically significant. Although the EMS teachers generally reported enthusiasm for teaching mathematics and greater satisfaction with planning time, their instruction was not markedly different. It may be that teachers either were not purposefully selected for this role – based on demonstrated, high-quality instruction – or not supported through professional development to develop more effective teaching practices.

In our research related to the quality of instruction, we found that the potential benefits of specialization were not realized. Clearly, access to and engagement in high-quality, sustained, mathematics-focused professional development will be a critical tool for achieving the potential for expert instruction with EMS teachers. It is not enough to enjoy teaching mathematics, and the EMS teacher on a team should not be chosen solely on this criterion. Instead, selection should be based on teachers' demonstrated competence with teaching mathematics and commitment to improving their practice through professional development.

Take-Away 3 – Instructional Time

One common concern for team teaching structures is the instructional time that is lost with transitions between classrooms. Our study relied on teachers' self-reported data of instructional and transition time; however, teachers' accounting of their students' time in instruction and time lost to transition provides valuable information about the planning of students' schedules in team teaching models.

Comparisons of the data in Table 1 indicate that there were no statistically significant differences for time spent in mathematics instruction or time lost to transitions. Interestingly, each of the measures is in favor of the team teaching structure with more instructional time and less time lost to between- or within-classroom transitions. In several cases in our study, we found that teams had intentionally arranged schedules to capitalize on transitions. For example, a team of teachers might switch classrooms after/before a special or recess in order to minimize lost instructional time. As Saralynn, a 4th grade teacher, describes:

> In between the two classrooms they only switch once. All the other switches happen because of recesses and the interventions…. But my partner and I have designed that schedule specifically with the block of Literacy to limit the number of switches in a day. It takes up a lot of time.

Table 1: Average time spent in mathematics instruction and transitions

	Elementary Mathematics Teachers	Self-Contained Teachers
Minutes spent per class of students in mathematics instruction per week	361	331
Total minutes of between-classroom transition time per day	27	29
Total minutes of within-classroom transition time per day	11	15

The EMS teachers in our study indicated that, once scheduled, this instructional time was well-protected. Because these teachers were unable to run over by a few minutes or come back to something later in the day, they were more aware of how they used their instructional time. However, being unable to run over by a few minutes or come back to something later in the day were significant challenges for EMS teachers, as they lacked the flexibility to stretch or add time to meet their instructional needs.

Take-Away 4 – Student Support

As the number of teachers on a team increases, the number of students served by the teachers on this team likewise increases. This is a great concern to those who question the developmental appropriateness of team teaching structures in elementary grades. At the root of this concern is the preservation of the singular relationship between students and their self-contained teachers and all of the social, emotional, and academic support this provides.

EMS teachers in our study described benefits to the students from team teaching that cannot be provided in a self-contained classroom. They indicate that having multiple team teachers allows for multiple sets of eyes to pick up on issues that students may be having. As one 5th grade teacher explained:

> There's been students we've been concerned about – not just academically but really concerned about their behavior, not they're active and disruptive but more like socially concerned and then we've been able… are you seeing this in your classroom as well?… I can think of three students that we have all had a pulse on much more this year in the first three months of school that I think we've been connected with.

EMS teachers may also find that something works for a student in one classroom that the other teachers may replicate to better support a student's needs.

The physical act of moving to different classrooms during the day also allows for "fresh starts" for the students and teachers. Salome, a 5th grade science specialist in our study, captured what she called a "clean slate" with each transition:

> This way the teacher and the kids, every 75 minutes, you've got a clean slate, somebody who is not done with you yet. And I think that speaks to a lot of the kids who have historically been troubled kids, had problems sitting and focusing and working … it's a completely different world every 75 minutes. And I think that helps a lot of the kids stay engaged.

When students have a situation develop in one classroom, a new setting allows them to put aside the situation and begin again.

The comparison of self-contained and EMS teachers' survey results suggests that EMS teachers believe they are as capable of meeting the needs of their students. With the exception of knowing the strengths and weaknesses of the students in English language arts, there were no significant differences between self-contained and EMS teachers' perceptions of their abilities to know and meet the needs of the whole child (Table 2). It may be that students in team teaching situations benefit when the team focuses on meeting these needs. One multi-grade EMS teacher indicated that her knowledge of and relationships with students were both strengthened:

Table 2: Knowing and meeting the needs of the whole child

Please provide your opinion about each of the following statements: (1 – strongly disagree to 6 – strongly agree)	**EMS Teachers (Mean)**	**Self-Contained Teachers (Mean)**
I know the strengths and weaknesses of each of my students in math.	5.29	5.41
I know when each of my students is struggling or succeeding in math.	5.38	5.47
I have enough time with my students to meet their needs in math.	3.58	3.35
I know the strengths and weaknesses of each of my students in English language arts.	4.13*	5.41*
I know when one of my students is struggling with organization.	5.42	5.71
I know the social and emotional needs of each of my students.	5.42	5.41
I know when one of my students is having a bad day.	5.71	5.71
I have enough time to meet the social and emotional needs of all of my students.	3.33	3.35
I have enough time to meet with other teachers and support staff about the needs of my students.	3.67	3.06

> It's really nice to have that connection and that connection with all the kids. I love that. And then having that…just that knowledge about the students who are…. if one of my homeroom students is having a hard time in my room, the three of us talk about that and we can talk about what that same student is doing in science and what that same student is doing in writing…. There's three of us who spend time with that child who have things to bring to the table. And so it's just all of us getting to know all of our students on a deeper level. I had worried that I wouldn't have as strong of a connection with my homeroom but what's happened is that I have a strong connection with all the 4th and 5th graders now.

EMS teachers consistently reported more attention on individual students and their needs during their collaborative planning time, since their ability to focus on content planning was limited.

The four take-aways of this study – focus, professional development, instructional time, and student support – indicate that team teaching offers great potential as an alternative to the traditional, self-contained classroom. EMS teachers find that specialization in mathematics provides opportunities to focus in their planning time, classroom environment, and professional development. Despite these advantages, there is also evidence that EMS teachers' quality of instruction may require a sustained commitment to high-quality, mathematics-focused professional development. In contrast to concerns raised relating to team teaching models, EMS teachers report that instructional time is not negatively impacted by transitions between classrooms, and they are as capable of meeting the social, emotional, and academic needs of their students.

Pitfalls and Fixes

Despite the potential that team teaching offers teachers and students, team teaching is a significant instructional shift. Several months may be needed to examine and weigh the possible team teaching structures, consider the strengths of the classroom teachers, negotiate the scheduling with stakeholders, and plan for other logistical challenges. In Table 3 (next page), we highlight pitfalls that may be encountered and potential fixes for each.

With thoughtful preliminary planning, a new team of teachers can avoid many challenges that may otherwise doom team teaching from the start. Team teaching has many stakeholders, including parents, specialists, and other teachers. Examining the possible impact for all stakeholders and establishing a team working relationship between the teacher members of the team can support the new team in getting off to a positive start.

Conclusion

Our investigation of EMS and self-contained teachers suggests that team teaching has the potential to create opportunities for more students to be impacted by passionate, knowledgeable, elementary mathematics teachers. Rigorous standards (e.g., the Common Core State Standards for Mathematics), as well as recent calls for effective teaching practices, demand that elementary schools use effective mathematics teachers to their maximum benefit. If implemented thoughtfully and with a continuing commitment to improving instruction, team teaching may make this possible.

This continuing commitment to improving instruction is critical to utilizing a content specialization model to its maximum benefit. Twenty states (including the District of Columbia) offer a Mathematics Specialist Certification, and many institutions in these states have initiated programs that support the development of effective mathematics teachers, interventionists, and coaches (Rigelman & Wray, 2017). Elementary schools that commit to content specialization in mathematics should simultaneously commit to supporting their EMS teachers in becoming certified as specialists (where available) or engaging in professional development that supports their ability to engage all students in the eight effective teaching practices (National Council of Teachers of Mathematics, 2014). Otherwise, the benefits of content specialization may be limited to factors related to teacher satisfaction (e.g., adequate planning time) and not extend to better instruction or improved student learning.

With the lingering challenges that students in the United States still encounter with learning mathematics, it may be time to challenge the traditional, self-contained structure that is prevalent in elementary classrooms. And it might be an ideal time to thoughtfully and carefully experiment with the professional development and effective use of EMS teachers. ✪

Table 3: Pitfalls and fixes associated with initiating team teaching

Pitfalls	Fixes
Consistency – Students may experience different behavioral and academic expectations between classrooms. Students' preferences for teachers and teaching styles can vary significantly between teachers.	Team teachers often describe their relationships with other members of the team as a marriage. Take this into consideration when choosing members of a team. Teachers' behavioral and academic expectations should be fairly consistent. Yet, teachers' strengths and weaknesses should be balanced and contribute to an overall team composition. Team members should be able to capitalize on other team members' strengths and compensate for other team members' weaknesses.
School Buy-In – Teachers and administrators consistently remarked on the challenge of creating a schedule that would work with specials, lunch, other grade levels, etc.	Before planning a team teaching schedule, discuss the prospect with all other school faculty and administration. Explain why you would like to try an alternative to self-contained classrooms, along with its benefits and challenges for different stakeholders. Get everyone on board, because they may all have to make small sacrifices to make it work.
Parent Buy-In – Parents will likely be concerned about their children's ability to adjust to a situation involving multiple teachers, classrooms and transitions. Understandably, they do not want their children to be lost, literally or figuratively.	Present parents with a clear plan and rationale for the change in structure. This rationale may include the take-aways discussed above. Teachers should also explain how they have thought through potential pitfalls, and how they plan to make sure that the transition to the new structure is smooth and the team is effective in meeting students' needs. In addition, it may be worthwhile to explain how and why particular teachers were chosen to teach the content areas.
Schedule – Students may lose focus and time in instruction with multiple between-classroom transitions during the day.	Schedule the between-classroom transitions to coincide with other transitions during the day, such as transitions to and from lunch, recess, or specials. Plan ahead for how students will transition their materials (e.g., books, binders, pencils) between classrooms.
Flexibility – Rigid team teaching schedules limit flexibility during the day. Transitions may be rushed, thereby interrupting content or assignment completion.	Schedule blocks of instruction with individual teachers. For example, if one teacher teaches both mathematics and science, schedule these back to back to allow for some flexibility between times for these content areas. Support team members' efforts to follow up with students in your homeroom who may need extra time to complete an assignment. Consider flexing time schedules every week or two to make up time that some classes may be missing.
Social, Emotional, and Academic Needs of Students – With more students, teachers may find it challenging to get to know all of their students.	Plan team events that develop students' and teachers' sense of a team community. Use common planning time to collaborate around students' social, emotional, and academic needs. Value other teachers' perspectives and relationships with students.
Home-School Communication – Parents need to understand the communication from school, and know how to communicate with their children's teachers.	Have a team parent meeting and/or directions sent home about communication. Address the following questions: • How will homework be communicated to students and parents? What steps will the team teachers take to ensure that homework is reasonable? • How will other school announcements be communicated to students and parents? What steps will the team teachers take to ensure that communication is not overwhelming or contradictory?
Conferences – The demands on teachers for additional conferences are significant.	Develop a conference plan that allows for all parents to receive information about their children in each content area without expecting whole-team conferences for each child (unless this additional time is planned for). Encourage requests for whole-team conferences for any concerned parent.
Content Collaboration – Elementary mathematics teachers have fewer opportunities to collaborate with other teachers around content at their grade level.	Identify other grade-level content teachers throughout the district with whom to collaborate. Common planning time is difficult with teachers outside of your school, but the establishment of an online or after-school collaborative group can alleviate the feelings of content isolation. Alternatively, collaboration with elementary mathematics teachers at other grade levels can be a good source of professional development of understanding how content develops and aligns vertically.

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