Developing Math and Science Teacher Pedagogical Skills Through Electronic Mentorship

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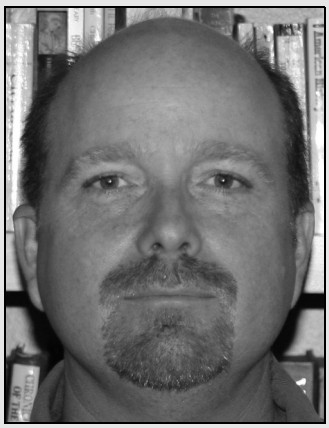
The Problem

The National Commission on Teaching and America's Future (2003) states that "teacher retention has become a national crisis" (p. 21). The attrition rate for teachers with 1 to 3 years experience ranges from 20 to 30% (Darling-Hammond, 1997).

In addition to this problem, many school districts are faced with a shortage of qualified math and science teachers. According to Ingersoll (2007), over half of all teachers leave the classroom within 5 years and the demand for new math and science teachers exceeds the supply. Ingersoll's analysis of the data indicates that the solution to the teacher shortage must include efforts to both recruit and retain teachers. Ingersoll also makes the case that retention can only be made possible by improving the conditions of the job including increased support for teachers.



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Furthermore, educators in states with low population densities and geographic isolation often experience difficulty providing induction and mentoring for secondary teachers (Simonsen, Luebeck, & Bice, 2007). It is not unusual for smaller schools to have a single teacher working in a specific discipline such as life science or algebra. For newer teachers assigned to these positions, it is often difficult to find a peer with whom to collaborate. In a 2001 study, Luft and Cox found that only 20% of beginning mathematics and science teachers in southwestern states had access to an induction program of any kind; none of the programs addressed the unique requirements of teaching mathematics and science (Simonsen et al, 2007). The problem is that while a given school site or district may have an induction support person, the chances that he or she will be teaching

the same subject and grade level are low. And while this individual may provide general support in the areas of classroom management, lesson design, and assessment, he or she is qualified to offer little in the way of advice on how set up a dissection lab or how to scaffold geometric concepts for 10th grade students.

A potential solution to this problem is structured computer-mediated communication (CMC) between new teachers and mentors capable of providing support in specific subject-matter areas and grade levels. In recent years, online learning has been implemented in an ever-expanding array of business and academic applications; mentoring for beginning teachers is one such example (Simonsen et al., 2007).

Distance mentoring or e-mentoring is a relationship established primarily using electronic communication between a "more senior individual" and a "lesser skilled or experienced individual" that is intended to "develop and grow the skills, knowledge, confidence, and cultural understanding of the lesser skilled individual to help him or her succeed, while also assisting in the development of the mentor" (Single & Muller, 1999, p. 3). It is further defined as a "formalized program environment, which provides training and coaching to increase the likelihood of engagement in the e-mentoring process," (Single & Muller, 1999, p. 3). E-Mentoring for Student Success (eMSS) is a program recently developed to support these tenets by providing math and science teachers with formalized and ongoing support in their specific subject-matter areas.

What is eMSS?

eMSS is a national network of math and science educators and professionals focused on supporting new math and science teachers as they enter the profession. The goal is to ensure that all eMSS beginning math and science teachers have the resources and veteran advice to provide quality instruction to their students. In the program, each beginning teacher is assigned a mentor from the same grade and discipline. The program focuses on their work together as they study content and pedagogy facilitated through an online curriculum that directly applies to the teacher's classroom. ("Introducing eMSS," n.d.). Mentors and their assigned mentees work in collaboration with other mentors and mentees and interact with university faculty and program facilitators who are regularly involved in the network ("The New Teacher," n.d.-b). The eMSS network is designed to promote professional development through dialogue and offers content-focused mentoring program inclusive of training, stipends, and program administration. Leadership and professional development opportunities are also made available for participating teachers ("Introducing eMSS," n.d.).

The Program's Inception

The eMSS program was started in 2002, when the National Science Foundation awarded a 5-year grant to the National Science Teachers Association, the New Teacher Center at the University of California at Santa Cruz, and Montana State University's Science/Math Resource Center to develop the eMSS project (Kepp & Mike, 2009). The initial goal was to offer a structured online program to facilitate support and communication for new science teachers. In 2007-2008, the program was expanded to include mathematics teachers through additional funding from Goldman-Sachs who desired to help build a program specifically for math teachers ("Introducing eMSS").

The program began with 12 school districts and rural consortia in Montana and California, ranging in size from 315 to 34,436 students. The partnership designed, piloted, and expanded the induction program to eight states through the first four years of its existence. By year five, educa-

tional organizations in 16 states were participating (Taylor, 2007). To date, over 1,500 mentees have collaborated with over 500 mentors in all 50 states to positively affect instruction for over 250,000 students ("eMSS: e-Mentoring," 2008).

The Need for Math and Science Teachers

Numerous reports have outlined the crisis facing math and science education in the United States. The National Academy of Sciences, in its 2005 report, "Rising Above the Gathering Storm," point out that the state of science education in this country is deteriorating compared to the rest of the world and that this has the potential to imperil the nation's economic future. Increasing student achievement is at the forefront of educational reform, and research has shown that teacher quality has a significant impact on student performance (Kepp & Mike, 2009).

Why Mentoring?

The concept of mentoring beginning teachers is not new. Many districts and educational agencies administer induction programs that provide professional development to beginning teachers (Kepp & Mike, 2009). While the programs may vary in numbers of personnel and the means by which mentors communicate with inductee, all programs are designed to increase teacher retention by providing support to teachers during their first few years of teaching (Kepp & Mike, 2009). A key component of many induction programs is mentoring: matching a beginning teacher with a more experienced teacher for support.

The Alliance for Excellent Education (2004) states that secondary teachers have unique induction needs, and content-specific mentoring is recommended as a way to provide support. Even programs with ample funding and a plethora of resources may be challenged to provide subject-specific mentoring for secondary math and science teachers due in part to the lack of availability of qualified and willing mentors in specific subject areas. Additionally, there is the issue of teachers' equal access to high-quality induction and mentoring. For example, in a 2002 study, Kardos and Johnson found that 61% of teachers in high-income schools were matched with mentors at the same grade level, as compared with only 28% in low-income schools (Kardos & Johnson, in press).

Obviously, districts in rural areas, possessing smaller schools or lying in areas of low income, may have a difficult time pairing new teachers with mentors possessing similar grade level and subject-matter experiences. And this need for support is crucial for these teachers' success in the classroom.

The Need for New Teacher Professional Development

Feiman-Nemser (2001) notes that successful teaching practice requires coherent and sustained teacher development from preservice preparation through the early years of teaching. Teacher induction can help ease the transition from being a student to becoming a teacher; in fact, a well-designed induction program can increase beginning teacher effectiveness during the early years of his or her career (Simonsen, et al., 2007). Also, professional development that focuses on how students learn, pedagogical content knowledge, instructional practice, and disciplinary content knowledge can lead to improved student achievement (Kepp & Mike, 2009). Borko (2004) argues "to foster students' conceptual understanding, teachers must have a rich and flexible knowledge of the subjects they teach" (p. 5).

How Distance Learning Through eMSS Meets Educators' Needs

In 2006, the Southern Regional Education Board (SREB) revised the National Staff Development Council standards for professional development and adapted them for online professional development. The SREB identified six necessary components of online professional development. They include:

1. active learning;
2. disciplinary content knowledge;
3. pedagogical content knowledge;
4. collaboration and reflection;
5. long-term and sustainable; and
6. responsive to teachers' needs.

The eMSS program encompasses all of these components and uses their online environment as a means of connecting experts and materials to new teachers through meaningful dialogue and relevant, classroom-centered learning activities.

eMSS Online Program Tools and Components

The underlying component of the online mentoring program is the technology that supports the interaction. To ensure successful communication between educators potentially separated by vast physical distances, the technology platform must be easy to use, be customized to meet the unique needs of an online professional learning community, and provide a variety of tools. The eMSS program utilizes the New Teacher Center Learning Environment, powered by the Sakai platform. The platform is web-based and is compatible with different operating systems and varying Internet connectivity. The platform includes a log in and password for all users to ensure privacy and security. To support new users, an orientation to the online environment is provided, with access to multimedia tutorials, help documents, and technical support staff for troubleshooting. Dedicated technical support staff are available to respond to the needs of users of all ability levels and to help with requests in a timely manner that is attentive to each user's specific needs (Kepp & Mike, 2009).

Mentees' main connection to eMSS is with their mentor in an area of the platform titled "Our Place." Our Place is a private discussion area for the mentee and mentor. Here, mentees complete much of their work for eMSS, including guided discussions that are called Inquiries. Our Place also serves as a communication vehicle where mentees can securely access help from a peer who is removed from that teacher's district/site level politics and issues. Our Place provides a running "threaded" record of mentees' discussions with their mentors so that either can easily refer back to them if needed (The New Teacher Center, n.d.-c).

The "Mentee Place" and "Mentor Place" are discussion forums for larger groups of mentees and mentors. The Mentee Place allows mentees to share ideas and connect with other beginning teachers across the country. Mentor Place offers ongoing professional development and support for mentors (The New Teacher Center, n.d.-c).

"Inquiries" are online conversational guides designed to help mentees (with the help of mentors) to deepen their teaching practice and boost their effectiveness with students. The Inquiries, which form the core of the eMSS program, are online conversations based on classroom practices. Each Inquiry is flexible and adaptable to a mentee's own specific classroom needs. A group of mentees and mentors, guided by a facilitator, work together on an Inquiry over a period of 8 weeks. There are three sessions of Inquiries offered during the year: fall, winter, and spring. Each session offers a choice of topics so mentees can select an area relevant to their teaching. Teachers participating in Inquiries follow a

"plan, practice, and reflect" cycle. This cycle allows mentees to dig deeply into a topic in a manner that can then be applied to other aspects of their teaching (Kepp & Mike, 2009).

Teacher leaders and practicing scientists and mathematicians facilitate the Community forums and resources areas. They are used to pursue content-focused discussions, dilemmas of practice, and to access a wealth of additional resources (The New Teacher Center, n.d.-c).

Throughout the online platform, eMSS offers an array of resources that are selected by program staff, members of the National Science Teachers Association, and the content specialists in the program. The comprehensive resource area is further organized into categories for ease of use. Program participants also have opportunities to share personal resources. To ensure the quality of these materials, content specialists and facilitators regularly view the personal resources that are posted (Kepp & Mike, 2009).

The eMSS online platform offers multiple venues for collaboration for the beginning teacher: with a mentor, with a small, self-selected group discussing a dilemma of practice, with content-focused small groups, and with content specialists (Kepp & Mike, 2009). With this arsenal of resources at his or her disposal, the mentee can be assured of finding help, regardless of the issue.

The Participant Selection Process

Organizations and agencies such as school districts, departments of education, and other educational organizations begin by applying into the program. Once accepted, they may recruit and select beginning teachers who must then complete an application ("eMSS: e-Mentoring," 2008).

First through third year middle or high school educators teaching math and/or science may apply into the program to become mentees. Applications are available in May for the next program year and potential mentees are notified in late June of their acceptance into the program. Selected mentees must complete an initial online orientation and participate on a weekly basis in the eMSS online site as they work with their mentor on the curriculum in the eMSS environment (The New Teacher Center, n.d.-a).

There is also a rigorous mentor selection process to ensure that these support providers possess the necessary skills and attributes. Potential eMSS mentors must be experienced math or science teachers with a minimum of 5 years teaching experience (the average eMSS mentor has 12 years of teaching experience). Mentor selection is a multiphase process beginning with an application. In order for a mentor to be accepted into the eMSS program, he or she must first sign a letter of agreement with the New Teacher Center and successfully complete a 3-week, online summer institute. While participating in the institute, potential mentors are engaged in intensive professional development with the goals of building trusting relationships, maximizing their ability to interface with the online platform, and understanding the role of a mentor and the online learning environment (Kepp & Mike, 2009). Furthermore, mentors participate in ongoing professional development throughout the year to ensure the beginning teachers are supported effectively (Kepp & Mike, 2009). Mentors must provide quality online dialogue and work with three to five mentees to guide them through all aspects of the eMSS environment. They must also participate frequently in the eMSS online site; posting a minimum of two to three times per week and must participate in at least two Inquiries during the school year ("eMSS: e-Mentoring," 2008).

Program Benefits

The benefits for the mentee come in the form of expert support from an individual mentor with experience in the same math or science discipline or grade level, access to a nationwide network of math and science teachers, and access to content-focused online support for the classroom, as well as a guided curriculum that engages mentees in planning, applying practice to their classroom, and reflection with their mentor and a group of teachers working on similar goals. Mentees who meet all program requirements receive verification of professional development participation and have the option to receive college-level academic credit to help increase their standing on many districts' salary schedules ("eMSS: e-Mentoring," 2008).

eMSS mentors also receive a number of benefits as participants in the program. They may earn stipends ranging from $1400 to $3,000 per year, depending upon the number of mentees for which they are responsible (the maximum number allowed is five). They also have immediate access to a nationwide network of other mentor teachers, university faculty, and have the opportunity to increase their skills through online mentor professional development ("eMSS: e-Mentoring," 2008).

Data on the Program's Success

To ensure the program is optimized to meet participants' needs, eMSS program staff administer pre- and postsurveys to the entire participant pool, which can be disaggregated by program. In addition, data regarding the amount of activity and postings are also available for each program (Kepp & White, 2009). Evaluation of the program has shown that beginning teachers participating in eMSS have reported a significant increase in preparedness in basic teaching and management skills, and the eMSS components have enhanced their ability to teach science, and participation in the content areas improved their understanding of the content (eMSS conference proceedings). A study conducted by Taylor (2007) on the eMSS program indicates that facilitators of the eMSS online conferencing systems can promote improved dialogue, with the potential for increasing participants' learning related to the program goals. The results of a 2005-2006 study suggest that this type of private, paired discussion environment appears to successfully support trust building and relationship growth, as mentor-mentee pairs exchange many messages about home, family, and non-teaching-related issues. The results of this study further suggest that private, paired discussion facilitates a strong bond that links mentees, their mentors, and the classrooms in which they teach (Simonsen, Luebeck, & Bice, 2007).

eMSS Program Success

The eMSS program provides an exhaustive list of services for its members. Through the online platform, participants have access to a collaborative learning environment program with professional facilitation as well as an informational website that provides extensive content-area and pedagogical resources. High-quality, fully trained online mentors provide ongoing support to ensure that beginning math and science teachers enjoy success in the classroom. Program monitoring and ongoing evaluation ensure that the components of the program continue to meet goals and expectations.

References

Alliance for Excellent Education. (2004). *Tapping the potential: Retaining and developing high-quality new teachers*. Retrieved from www.all4ed.org/publications/TappingThePotential/TappingThePotential.pdf

Borko, H. (2004). Professional development and learning: Mapping the terrain. *Educational Researcher, 33*(8), 3-15.

Darling-Hammond, L. (1997). *Doing what matters most: Investing in quality teaching*. New York, NY: National Commission on Teaching and America's Future.

eMSS: e-Mentoring for student success. (2008). Retrieved from http://www.newteachercenter.org/pdfs/eMSS_brochure.pdf

Kardos, S. M. & Johnson, S. M. (in press). New teachers' experiences of mentoring: The good, the bad, and the inequity. *Journal of Educational Change*.

Kepp, L., & Mike, A. (2009). *eMSS: An online, content focused mentoring program for secondary math and science teachers* [White paper]. Retrieved from The New Teacher Center website: http://www.newteachercenter.org/pdfs/eMSS_whitepaper.pdf

Ingersoll, R. M. (2007*). Teaching science in the 21st century: The science and mathematics teacher shortage: Fact and myth* [Electronic Version]. NSTA Reports. Retrieved from http://www.nsta.org/publications/news/story.aspx?id=53821

Introducing eMSS 2009-2010. (n.d.). Retrieved April 1, 2009, from http://emss.nsta.org/

Luft, J. A. & Cox, W. E. (2001). Investing in our future: A survey of support offered to beginning secondary mathematics and science teachers. *Science Educator, 10*(1), 1-9.

National Commission on Teaching and America's Future [Electronic Version]. (2003). *No dream denied: A pledge to America's children*. Washington DC: National Commission on Teaching and America's Future.

Simonsen, L., Luebeck, J., & Bice, L. (2007*). Online paired mentoring of rural science and mathematics teachers*. In C. Montgomerie & J. Seale (Eds.), *Proceedings of World Conference and Educational Multimedia, Hypermedia and Telecommunications 2007* (pp. 2458-2465). Chesapeake, VA: AACE.

Single, P. B. & Muller, C. B. (1999, April). *Electronic mentoring: Issues to advance research and practice.* Paper presented at at the annual meeting of the International Mentoring Association, Atlanta, GA.

Southern Regional Education Board. (2006). *Standards for online professional development: Guidelines for planning and evaluating online professional development courses and programs.* Atlanta, GA: Author.

Taylor, P. S. (2007). *The effect of facilitator training on the development and practice of participants in an online induction program for teachers of science and mathematics*. Unpublished doctoral dissertation, Montana State University, Bozeman.

The new teacher center: Beginning teacher's application. (n.d.-a). Retrieved from http://www.newteachercenter.org/eMSS/menu.php?p=mentee-math

The new teacher center: E-mentoring for student success. (n.d.-b). from http://www.newteachercenter.org/eMSS/menu.php?p=community

The new teacher center: eMSS program overview. (n.d.-c). Retrieved from http://www.newteachercenter.org/eMSS/menu.php?p=overview

"THE RESULTS OF THIS STUDY FURTHER SUGGEST THAT PRIVATE, PAIRED DISCUSSION FACILITATES A STRONG BOND THAT LINKS MENTEES, THEIR MENTORS, AND THE CLASSROOMS IN WHICH THEY TEACH."