SciMathMN
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How Do We Best License Science Teachers in Additional Fields to Guarantee Quality Learning for Minnesota Students?

The Minnesota Board of Teaching has established the use of the PRAXIS II test as the means of granting additional licensure to teachers who have taught at least 3 years and are licensed in another discipline of science. The SciMathMN Board of Directors has opposed using the passing of a PRAXIS II discipline science exam as the SOLE measure of content knowledge for granting licensure in other areas of science at the 7-12 grade levels. SciMathMN would favor adding additional coursework to this new policy and supports the paths to licensure in additional fields of science that are currently offered by Minnesota universities and colleges and the use of the portfolio process.

Why is a test not enough for granting licensure in additional areas of science?
Clearly, a teacher ought to demonstrate content knowledge in the subjects he or she teachers. But it is equally important that a teacher demonstrate that he or she also knows HOW to teach a subject to children and young adults. In today's complex world, science is a critical area for improving a student's post secondary learning and work options. We need to guarantee strong learning in science for all of Minnesota students. By licensing teachers both on their content knowledge and their pedagogical knowledge we make that guarantee a more viable reality.

While appreciating staffing shortages that are real issues, particularly in smaller or isolated school districts, weakening or short-circuiting the requirements for teacher licensure may potentially create an unequal educational system. Larger school systems can continue to maintain staffs that are more thoroughly prepared to teach specific areas of science and smaller districts will only attract those who merely pass a content test.

The Minnesota Board of Teaching (BOT) approves teacher preparation programs in Minnesota and requires institutions prepare science teachers in a specific set of knowledge, skills, and understandings as required by the BOT. There is a process that Minnesota teacher education institutions use to prove to the BOT that their programs provide this detailed preparation to its graduates which includes comprehensive assessment of its graduates' mastery of the knowledge, skills, and understandings required of highly qualified science teachers.

The use of the PRAXIS II test, as the only measure of science content in an alternative path to additional science licensure, is in no way equivalent to what BOT requires of Minnesota teacher education programs. The PRAXIS II test, used alone, waters down the current Minnesota standards for licensure. Minnesota's current Academic Standards for Science require deep understanding in multiple areas of science and will most effectively be met by students whose teachers have deep knowledge of the content and pedagogical issues in teaching that content. As Minnesota moves into the first required assessment of science learning in 2008 will this rule need to be repealed since it short circuits high quality?

What has been done already?
The BOT has established a portfolio process that can document a teacher's performance and knowledge of science and science teaching. It is more comprehensive than an exam as it includes course work, professional development activities and teaching experience. Teachers have used this process to secure additional licensure but it can benefit from greater publicity.

Several MnSCU institutions and Minnesota private colleges have been preparing to meet this need. The MnSCU Second Licensure Programs at various institutions have begun to show success in generating programs that work for additional licensure for teachers already licensed in one area of science. This is available in all the licensure areas of science. Plans are underway by MnSCU institutions to expand their current offerings to one year programs designed for individuals already holding licensure in one area of science. These will consist of on-line courses, culminating in face-to-face summer work. The private colleges are also taking note of the need. Programs, such as the Minnesota Science Teachers Education Project (MnSTEP) developed at Hamline University have been developed. This program has two components, Physics Accreditation for Science Education (PhASE) and Chemistry Curriculum for Additional Licensure (ChemCAL). These combine summer experiences, online learning, and a practicum experience where the candidate is observed by a licensed teacher. Both programs are grant supported, resulting in little financial cost to participants. As the network of higher ed providers expands across the state, teachers in many areas will have access to programs that provide a greater degree of quality than an exam. The MnSCU and Hamline programs provide viable models for other institutions to develop similar programs.

Minnesota students have scored among the best in the world at grades 4 and 8 in the TIMSS '95 assessment. This is attributed to several factors including a strong inquiry pedagogy that has developed through professional development over time and an absence of ability grouping in science which permits the opportunity for all students to learn important science content. This provides a strong foundation for more focused work at the high school level. All students deserve to be taught by well-qualified teachers and it is critical that we continue to build on the strong elementary and middle school foundation our students have shown in the past as we implement new requirements. As we expect all students to take both life science and either chemistry or physics in high school, ought we not be more aggressive in ensuring that students will be able to be successful in that coursework? By having the instruction provided by teachers who know not only the content in physics and chemistry but how to teach that content to a wide variety of learners and to provide safe laboratory or field experiences in all content areas, we increase the guarantee that all students will have access to strong instruction in all areas of science.

It is a fallacy of conventional wisdom that content in one area of science transfers to another area of science. Clearly there is some transference. Inquiry as a process for learning is well documented and can transfer across multiple areas of science. But each discipline also has certain concepts that have a strong research base on how students learn them. Knowing how students learn ideas in biology may not be the same as identifying typical problem areas in physics or chemistry or earth science. In addition the safety issues in laboratory settings differ. Studying in a field experience in a biology class has a different set of requirements than mixing chemicals in a chemistry lab. Recent research in science education, published in a variety of juried science teaching journals, are showing that both content and pedagogical content knowledge affect student performance (see, for example, "Misconceptions as Barriers to Understanding Science," *Science Teaching Reconstructed*, www.books.nap.edu/readingroom/books/str/4.html). These studies show a positive relationship

indicating that a teacher whose content knowledge is greater than that of another teacher will more likely have higher student achievement. Likewise the pedagogical knowledge also correlates positively with increased student achievement. Teachers need specific training in the best ways to teach the key concepts of each science to guarantee student learning, retention of scientific ideas, and the ability to build on those ideas to learn additional content within an area of science. The deeper the content knowledge of the teacher AND the more familiarity a teacher has with the best practices/pedagogy and the potential misconceptions students hold or develop within each discipline of science, the stronger the science education will be for every child or young adult.

To maintain equity and to address the unique needs of smaller or isolated districts, regions might develop partnerships for sharing staff members. By sharing across semesters or through annual exchanges, a region might have a cadre of science teachers upon which to draw and be able to maintain high quality teachers for its students. Some models exist that might form a productive basis for creating similar systems in Minnesota. Dr. Roy Unruh, University of Northern Iowa, has pioneered a sharing effort among districts in Iowa to effectively deliver physics instruction to a greater number of learners.

What needs to be done?

The SciMathMN Board of Directors urges the following steps be taken:

1. Legislators and the BOT need to continue to encourage the development of coursework among Minnesota higher education institutions, who might work in conjunction with regional professional development agencies, to guarantee coursework and professional learning opportunities in both content knowledge and pedagogical knowledge. This increases the guarantee that Minnesota students continue to receive a science education that has been nationally and internationally recognized. Integrating on-line learning experiences and networks of educators can make the learning time and experiences workable for teachers in smaller or isolated school districts and for experienced teachers in all regions who already hold full time teaching jobs. These models should be disseminated through MDE, BOT, and professional organizations such as MACTE, MCTM, MnSTA, MASA. MASSP, MSBA, Education Minnesota. This may require judicious extension of variances as these programs phase in.
2. School districts and their professional organizations, including teacher contract organizations, might develop policies and share the costs of increasing the science areas in which a teacher is certified in exchange for a guarantee of continued employment in the district or region for a specified time period. This is often a condition of sabbatical leaves and could be modeled as a condition of district/regional support for additional licensures.
3. School districts might form professional, contractual relationships to regionalize their staffs to create models that allow a teacher licensed in one science to teach in multiple school districts. If there were creative “exchanges” across years or semesters, districts could offer a stronger variety of science course work to their students knowing they are providing students learning opportunities with teachers knowledgeable in both the science content and the pedagogy specific to that content area. It might be wise to pilot some models of regional collaboration to gain a sense of the logistics involved.
4. The Legislature or the BOT should appoint a task force involving key stakeholders to generate equitable solutions to the staffing shortage that will maintain a high quality education for Minnesota students in all areas of science, not just the area in which their teacher was first licensed.

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