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The Schoolwide Enrichment Model in Science

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Abstract

An in-depth understanding of science knowledge and the ability to utilize basic scientific skills is fundamentally important for empowering students to make critical decisions and understand the world around them. However, many instructors teach science using rote memorization, which often leads to a lack of interest and student engagement. This article describes the extension of a decades-old teaching model, the Schoolwide Enrichment Model, into the domain of science. By applying this engaging and authentic model, instructors may learn how to more fully engage their students in science.

Keywords:
science education
gifted students

1 Introduction

Science is an important component of every student's education, for it is through science that we come to understand the world around us. Through the study of science, we may develop the critical thinking skills so important for global citizens to make informed and thoughtful decisions regarding large issues such as global warming, the ethical use of technology, and more. Yet, in many countries, science education is ineffective or non-existent. Several reasons exist for this phenomenon, including the lack of time spent on science and a lack of student engagement. With a more engaging type of instruction, students' interest in science could be increased and deeper learning could occur.

1.1 The Problems with Science Education

What do we know about best practices in science education? Seminal researchers (e.g., Dewey, Bruner, Piaget) and writers in the field have advocated for many decades for a hands-on, minds-on approach to learning. However, we know that in certain developed countries such as the United States, science education is on the decline, for a number of reasons. First, the amount of time that has been devoted to the subject has been declining in recent decades, and this time has resulted in lower science test scores (Blank, 2012). Also, science is frequently taught in an abstract way through rote memorization through a textbook rather than through the types of rich and meaningful authentic experiences necessary to both engage them and increase learning. What can be done to make learning meaningful?

1.2 What Makes Learning Science Meaningful?

We know that learning is meaningful when it is authentic, but what does it mean to be authentic? First, the learning must be real – that is, it must focus on finding and solving a real problem. Next, it is best if the student has an emotional or cognitive connection to the problem. Finally, the problem should be complex and not easily solvable (Renzulli, Gentry, & Reis, 2014). Students who are allowed to tackle authentic problems may become junior practitioners, assuming the practices, habits and dispositions of the field. For example, a student who is interested in learning about the impact of pollution in a local estuary might assume the practices, habits, and dispositions of a marine biologist, using the tools particular to that profession to conduct a study, and completing an authentic project to document his or her findings.

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2 The Schoolwide Enrichment Model (SEM)

Drs. Joseph Renzulli and Sally M. Reis originally developed the SEM in the 1970s as a way to identify and teach gifted students. Grounded in the work of Jean Piaget, Jerome Bruner, and John Dewey, the SEM has been implemented at hundreds of schools around the world. The SEM is based on the premise that two types of gifted students exist: (a) "school-house gifted," or students who do well in the traditional aspects of school such as reading, writing, and mathematics; and (b) creative producers, or students who may not demonstrate advanced abilities in school, but who go on to produce achievements that exceed their peers in terms of quality or quantity. An example of a creative producer might be Albert Einstein, who did poorly in school, but who became one of the greatest scientists of the twentieth century. The SEM is also grounded in Dr. Renzulli's Three-Ring Definition of Giftedness, which states that children exhibit gifted behaviours when the three "rings" of creativity, task commitment, and ability come together (Renzulli, 1978). In the SEM, teachers' and administrators' responsibility is to put into place the circumstances required to nurture students' interests and abilities so that they will exhibit gifted behaviours.

2.1 Components of the SEM

At the heart of the SEM are a total talent portfolio and a core set of activities known as the Triad. The total talent portfolio is a collection of assessment results concerning students' strengths, interests, and learning styles. The identification of these individualized characteristic allows instructors to engage students through a core set of activities known as the Triad. These activities are classified into one of three types:

- Type I – activities which promote interest and engagement in students. Examples of Type I activities might include arranging for a guest speaker or a field trip, creating a classroom center on a topic and more.
- Type II – activities which promote skill development in students. For example, research, outlining and interview skills are all Type II activities which will empower students to conduct work on a topic.
- Type III – authentic projects, self-selected by students or groups of students that allow students to utilize the practices, habits, and dispositions of a discipline to study the topic.

In addition to Triad activities, the SEM affords a continuum of services to students which challenge gifted students; these services might range from advanced classes to strategic groupings for instructional purposes, mentorships, internships, enrichment activities, and more.

Students in the SEM are identified as gifted in an area based on multiple criteria – usually a combination of test scores, grades, teacher and parent referral, as well as self-nomination by students. This use of multiple criteria casts a wide net and, when implemented properly, usually results in the identification and screening of approximately 15% of the student population, a figure higher than when traditional IQ tests are used.

2.2 Results of the SEM

The SEM has been demonstrated the application of the SEM into other content areas to be highly effective. For example, in a study in which the model was applied to reading, students demonstrated greater fluency, higher comprehension, more self-regulatory behaviours, and more positive attitudes towards reading than peers who participated in a basal reading program (Reis et al., 2005). Much like the application of the SEM into science, SEM-Reading relies on engaging students through self-selection of topics of interest and authentic work.

3 The Schoolwide Enrichment Model (SEM) in Science

Through their publication, *The Schoolwide Enrichment Model in Science* (2015), authors Heilbronner and Renzulli have extended the model into science. Similar to the SEM, SEM-Science consists of a total talent portfolio, a triad of activities, and various support services.

3.1 Components of the SEM-Science

3.1.1 The Total Talent Portfolio in SEM-Science

Similar to the SEM, SEM-Science begins with the identification of students with potential gifts or talents in the domain. It is important to ask, "What does a gifted science student 'look' like in four areas: abilities, interest areas, instructional preferences, and expression style preferences?" Once the student's qualities in each of these four areas are evaluated, a specialized total talent portfolio is developed and used throughout the academic year to plan activities which target student's strengths.

Students' strengths in each of these four areas are identified and documented in the total talent portfolio. Two types of abilities in science may be measured – students' knowledge of the domain and students' abilities to "do" science through science process skills. Knowledge of science content may be documented with standardized and more informal tests, usually teacher-made, as well as course grades, while students' science process skills may be measured through science performance assessments such as the Diet Cola Test (Fowler, 1990) or product evaluations of such activities as science fair submissions.

SEM-Science includes a survey that engages students' interests in biology, physical science, chemistry, earth science, and astronomy. Instructional style preferences that measure how students like to learn may be measured with an Instructional Styles Inventory and include listening, discussing, reading, investigating, and working with technology. Expression styles, or how students prefer to demonstrate learning, include writing, verbally, through technology, through manipulatives, models or artwork. Once again, a comprehensive survey assesses students' preferences for each style.

Once students' abilities, interest areas, instructional preferences, and expression styles preferences are determined, a portfolio organizer that helps the instructor summarize the information is provided. Using this summary, the instructor understands at a glance the students' strengths, interest areas, and styles of learning.

3.1.2 The Triad in SEM-Science

The purpose of the Triad in SEM-Science is to engage students with interesting activities that challenge them to produce authentic work. As with the SEM, SEM-Science accomplishes this through the Triad.

Type I activities in SEM-Science engage students with learning, and fall into four categories:

- Activities that focus on *people* – for example, an instructor might invite a local veterinarian to her class to speak about the care of animals;
- Activities that focus on *experiences* – an instructor might take his class on a field trip to document flora and fauna in a wetland; and
- Activities that focus on materials or media – an instructor might set up a discovery center on magnets in her classroom.

Usually, after exposure to a type I activity, students are given the opportunity to debrief about what they liked, didn't like, and learned from the experience. Students who seem engaged may complete a form letting the instructor know they would like to learn more about the topic.

Students who wish to study the topic further may work with the teacher to identify an authentic learning project that focuses on the topic. To do so, they must learn a number of Type II skills, which may be thought of as tools in a toolkit which allow students to complete the work of practitioners in the field. For example, an archaeologist might need to understand geometry and mathematics in order to calculate the area of an archaeological dig. She might need to understand how carbon dating works to calculate the age of a fossil. Type II activities in SEM-Science includes the explicit teaching of skills that allow students to:

- Understand scientific explanations – including skills such as listening, reading, photographing, sketching, note-taking, outlining, and reference skills;
- Generate scientific evidence – including scientific practices such as observing, measuring, and more, as well as critical and creative thinking skills, and creative problem solving;
- Reflect on scientific knowledge – including the ability to evaluate risks, methods, and the motives of others; and
- Participate productively in science – including the ability to communicate through oral or written expression, technology, and more.

The teaching and application of these skills enables students to complete Type III projects, which are authentic projects that are complex and directed towards a topic of interest. Type III projects in the SEM-Science share four common characteristics:

- They focus on science problems in the real world;
- They are problems with which students have a personal or emotional connection;
- They are complex and have no simple solution; and
- They target an authentic audience and enable students to act as junior practitioners.

For example, if a student expresses interests in understanding how pollution shapes an aquatic environment, he might choose to measure and document the level and source of particular pollutant on a nearby body of water. Then, he could choose to advocate for change by informing the public and conducting a campaign to decrease the levels of the pollutant.

3.1.3 Beyond Triad in SEM-Science: A Continuum of Services

In addition to Triad activities, SEM-Science affords the learner a continuum of services that help to promote talent in the sciences. This continuum of services ranges from enriched or accelerated curriculum to clubs, competitions, and other co-curricular activities that encourages students to become more engaged with the discipline of science.

4 Conclusion

Students' lack of engagement with the sciences is a well-documented phenomenon that has been associated with a variety of causal factors. One of these factors is curriculum that does not encourage students to become engaged with the discipline and that focuses on rote memorization of facts. The Schoolwide Enrichment Model has now been extended into the domain of science, offering an opportunity for instructors to develop deeply engaging curriculum that draws upon students' individual strengths within the domain to empower them to act and think as junior scientists.

References

Blank, R. K. (2012). *What is the impact of decline in science instructional time in elementary time?* Retrieved from http://www.csss-science.org/downloads/NAEPElemScienceData.pdf

Fowler, M. (1990). The diet cola test. *Science Scope, 13*(4), 32-34.

Heilbronner, N. , & Renzulli J. S. (2015). *The Schoolwide Enrichment Model in Science.* Waco, TX: Prufrock Press.

Reis, S. M., Eckert, R. D. Schreiber, F. J., Jacobs, J., Briggs, C., Gubbins, E. J. & Muller, L. (2005). *The Schoolwide Enrichment Model Reading study* (RM05214). Storrs: University of Connecticut, The National Research Center on the Gifted and Talented.

Renzulli, J. S. (1978). What makes giftedness? Reexamining a definition. *Phi Delta Kappan, 60,*180-184, 261.

Renzulli, J. S., Gentry, M., & Reis, S. M. (2014). *Enrichment clusters: A practical lan for real-world, student-driven learning* (2nd ed). Waco, TX: Prufrock Press