Overview of science teaching yesterday today and tomorrow education essay

The development of science education in the United States is said to have been pushed by a perceived lack and deficiency with laggard innovations in science and the declining quality of students the science curriculum has produced. Reforms in the science curriculum in the past were triggered by Soviet Union’s Sputnik launch and how the event placed the US behind their Russian counterparts (Matthews, 1994). Today, in the era of globalization, a growing concern is the declining standards and performance of American students in mathematics and science. The challenge falls upon the entire American education system to ensure scientific literacy among its citizens and equip them with the scientific competency to become productive members of a democratic society.

This paper discusses the evolution of science education in the United States in order to evaluate how the science teacher or educator could initiate reforms in the classroom or the systemic setting.

Science Education: The Past

It is a common perception among students that science is a difficult and “ deplorable” subject in school (Krehbiel, 1999). Responsibility has fallen upon policy-makers and science teachers to make the sciences more appealing to students. As Stephen Jay Gould said, “ We think that science is intrinsically hard, scary, or arcane, and that teachers can only beat the necessary knowledge, by threat and exhortation, into a small minority born with inborn propensity” (as cited in Osborne, 2007, p. 117). Why has science education acquired this brand or label as a seemingly impossible subject which only a handpicked few could appreciate and comprehend?

The history of science education suggests that the rigidity, prescriptive curriculum, and standardized form of science teaching as a subject based on “ memorization of facts” on a very wide range of science content might have contributed to this perception (Matthews, 1994). The standardization of science teaching in the late 1800s was undertaken in order to address the problem of the lack of qualified science teachers. The school curriculum concept grew out of the London School Board in the United Kingdom in 1870, prompting the training of science teachers who can ably teach science courses to the general public. In the United States, the standardization of science education came in the 1890s and there was a great debate on what ideology should guide the school science curriculum: citizen science or professional training. In 1892, a group called the Committee of Ten was tasked by the National Education Association (NEA) to make recommendations for a school science curriculum. This committee emphasized on science teaching as a citizen science that is important in grooming professional scientists in the future. As a result, the entire American education system applied the curriculum recommended by this Committee (Wallace and Loughran, 2003). The emphasis was theoretical and stressed on the teaching of facts and principles of the disciplines. The approach was foundationalist, where the curriculum attempts to make the future scientist learn all the basic concepts of every science discipline. Cohen opines that the tradition of attempting to “ make students memorize a series of dry facts” was impractical because “ no practicing scientist readily memorizes such as the density of various substances, the atomic weight of different chemical elements… the distance in light years from the Earth to various stars (and so on)” (as cited in Osborne, 2007, p. 173). This tradition

still dominates science education today, but has also been challenged with the introduction of other ideologies to guide science teaching. One is the applied approach where science is taught in relation to how everyday things function and contribute to society, and the liberal or humanistic approach, where emphasis is given on the implications of science in a historical and cultural sense (Matthews, 1994).

Science Education: The Present

The same concerns still exist in science education today. Attitudes toward science and mathematics among students remain negative and parental support for a science-geared education has declined (Osborne, 2007). K-12 science educators in many states in the US still follow the rigid, theoretical tradition in science teaching and conform strictly to the curriculum and content prescribed among age groups. Policy makers and education lobbyists have expressed concern that emphasis on facts and theories have resulted to teachers who merely “ cover” the material, without “ teaching” the material. The process of science is overlooked and the student fails to develop critical thinking skills and appreciation for the scientific method. Osborne (2007) articulates the tension in science teaching today. She argues that the science curriculum is geared at developing future scientists, hence, the stress on factual and theoretical presentation on a wide range of content. This contributes to the perception that becoming competent in science is practical only to students who want to pursue a career in the sciences someday. The aim of scientific literacy for all citizens is missed if this kind of thinking is not corrected. According to Krehbiel (1999), science teachers have the responsibility of clarifying to students that science competency is

not only suited for the future scientist, it is also beneficial to non-scientists. Scientific literacy contributes to the development of problem-solving skills that greatly benefit non-scientists and can be applied in everyday life.

Science education development today wants to enhance the competency of teachers. Teachers are central to the development of scientific literacy which is the end goal of science education (Osborne, 2007). Their qualifications and their attitudes play a great role in accomplishing this mission. State Boards have specific requirements and credentials for science teachers. Studies have shown that teachers who possess subject-specific degrees are better qualified to influence positive science outcomes among students than those who do not (Cronginer et al., 2003). However, secondary characteristics such as teacher's attitudes and belief systems play a major role in motivating students to learn. Wallace & Loughran (2003) suggest that there are many factors that contribute to the belief systems of science teachers, such as social pressure (or the need to conform to prescribed methods of instruction) and the " apprenticeship of observation" (or the mirroring of style of teaching they experienced as students in their science classes).

Attitudes about practice reflect upon a science teacher's teaching style, which in turn influence comprehension. Teachers who consider themselves as " transmitters" of knowledge apply a teacher-centered style of instruction where the main goal is the delivery of the content or subject matter (Wallace & Loughran, 2003). A teacher who espouses this tradition adheres strictly to the organization of content while the needs of students are secondary considerations only. Lesson plans are designed to conform to prescribed content with no concern for student readiness or aptitude. Wallace and

Loughran (2003) identify this method as the most dominant form in science teachers. An alternative style is the “ student-centered” method which focuses primarily student’s comprehension. A teacher who practices this style first considers his or her students’ prior knowledge or aptitude before planning lessons and concentrates on forming social interactions or collaborative relationships with students (Wallace & Loughran, 2003).

Science Education: The Future

If the international rankings of American students in science and mathematics are predictive of the quality of science education, then there are great challenges to be overcome in the near future. As American students lag behind their European and Asian counterparts in science competency, reforms in policy and corporate support are today heavily emphasized to produce more globally competitive students in the future. Microsoft founder Bill Gates has contributed billions to encourage students to take science course in college. Organizations such as Tapping America’s Potential provide scholarships for more students to graduate with degrees in science, mathematics, and engineering (Osborne, 2007).

In the education system, policy reforms are also under way. In 1996, the National Committee on Science Education Standards and Assessment (NCSESA) came up recommendations on how to better produce more scientifically literate students for the future. Standards related to science teaching were presented in the book National Science Education Standards, such as:

The vision of science education described by the Standards requires changes throughout the entire system.

What students learn is greatly influenced by how they are taught.

The actions of teachers are deeply influenced by their perceptions of science as an enterprise and as a subject to be taught and learned.

Student understanding is actively constructed through individual and social processes.

Actions of teachers are deeply influenced by their understanding of and relationships with students. (p. 30)

Among the reforms in elementary and secondary science education emphasize on the need for “ inquiry-based” and “ hands-on” curriculum used in schools. It has been a major thrust advocated in the National Science Education Standards and the American Association for the Advancement of Science.

Conclusion

The development of science education has been made possible by the careful study of its past, an assessment of the present, and a positive outlook on the future. Remnants of the heavily theoretical orientation of science teaching of the 19th century are still practiced today. At present, there has been a noticeable decline in the competency of students in science and mathematics, pushing the drive for more reforms in science education. The recommendations, while focusing on the systemic need for science

education reform, also highlight the important role of the science teacher in achieving better science outcomes among students. Teachers’ competency, decisions about the content, peer interactions, behaviors, attitudes, and belief systems significantly influence students’ comprehension, appreciation, and attitudes toward science.