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The quality of textbooks used in science education: a study of four schools serving deaf students

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<u>The Quality of Textbooks Used in Science Education:</u>
<u>A Study of Four Schools Serving Deaf Students.</u>

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Abstract

Over the years, science achievement scores in the United States have been declining despite the movement towards reforming science and math education. A review of the literature reveals that the issue of the quality of textbooks used in science education is not often mentioned. In this paper, the author evaluates the quality of textbooks used in science education in four schools and discusses the findings relative to curriculum reform. Two Public and two Deaf Residential schools were surveyed, one each respectively, from the state of New York and Pennsylvania. Only the books used in 11th-12th grade science classes were evaluated. The criteria used to determine the quality of the textbooks are: the use of adjunct questions, the use of vocabulary words, the incorporation of hands-on activities, and the age of the book. In addition to these criteria, a survey was also given out to the teachers who use the books asking about their evaluation of the textbook.

Overview

Recently, the education system has come under fire about the overall declining scores of students on national achievement tests. This continuing decline in scores has been studied since the late 1960's. This is not only true for general education, but for the education of the deaf as well. The education system for the deaf seems to parallel the trends in education as a whole, but perhaps at a slower rate due to the unique factors involved in educating deaf students. How does science come into the picture? Of all the general content areas, the greatest decline in scores have been in science and mathematics. This is a national concern today because the "real" world is becoming increasingly dependent on technology, most of which is derived from knowledge of science and mathematics. This dilemma has brought about many proposed educational theories and reforms to improve the educational system with the goal of producing more knowledgeable students.

Standards

The National Science Foundation and the Department of Education (1980) have found that the United States has been falling behind other industrialized countries in the quality of the educational system. They reported that those other countries place a higher importance on science and mathematics and are striving to attain a high level of technical competency in the general population. In addition to declining scores, participation of students in science courses and the standards of such courses have also been significantly declining.

Keeves and Aikenhead (1995) shows that across the countries, there is little difference in the emphasis placed on the fields of biology, chemistry, and physics. However, this does not mean that all countries reach an equally high standard of achievement in those areas. In the field of earth science, geology, and geography, the emphasis is considerably less. An interesting trend today is that in some countries, rarely in western countries, the topics from behavioral sciences are being incorporated into the physical science courses. Most countries have a low turn-over rate with the group of students who are interested and stay with the sciences throughout school. This is a fairly large group as compared to the groups in other content areas. Whereas in Sweden, Thailand, and particularly in the United States, that group is getting smaller. In addition to these findings, the report also noted that the emphasis on science processes across the countries is mostly on knowledge, observation, problem-solving, interpretation of data, manual skills, and attitudes. There is a low level of emphasis on the science processes of the formulations of generalizations, model building, and the limitations of science and scientific models. There is also a trend of decreasing emphasis on the application of science in most countries.

The American Association for the Advancement of Science, (AAAS) (1989) and Rutherford and Ahlgren (1990) agree with the notion that the quality of science education in the U.S. has been declining in quality over the years. They both cite the declining achievement scores in science and mathematics. They both also report that the present curricula in science and mathematics are both overstuffed and undernourished. In other words, teachers and students are finding it increasingly difficult to know what is important due to the overabundance of information in less detail or the absence of information in some areas deemed less important. They also note that fewer elementary schools provide a fundamental science or mathematics program for their students.

College Entrance Examination Board (CEEB) (1986) and Mullis and Jenkins (1988) report similar findings. The United States ranks last in biology, and close to last in chemistry and physics as compared to most other countries. They also find that achievement of girls in science and that of ethnic/racial “minority” students lag significantly behind those of white, male peers. In addition to these findings, they report that the opportunity to learn science has been decreasing over the years, especially for girls and minorities.

AAAS (1989), Rutherford et al. (1990), and Keeves et al. (1995) all report that technology is in the education of sciences and mathematics, but its use is now on the decline.

Educational Theories and Reform

Keeves et al. (1995) focused on four changes that have happened in education, especially in science. The changes are: a move toward universal secondary and lifelong education, increased emphasis on learning to learn, science-related social issues, and technological change. The responses in science education to these changes, which did not occur across all countries, have included the introduction of environmental science courses, the growth of Science, Technology, and Society (STS) movement, some incorporation of aspects of other content areas into science areas, the establishment of technology as a mandatory subject in the curriculum, and the increased emphasis on investigation in science.

Duit and Treagust (1995) focus their research on the current movement in the constructivist approach, which is becoming increasingly popular in science education. The basic principles focus on encouraging the following: conceptual change, conceptual growth, experiments in learning science, cognitive conflict, and improving meta-knowledge. This research concludes that too often in science, the instruction is often limited to the recall of factual knowledge without understanding. The research also provides recommendations to educational administrators and policy makers for improving science education.

Both AAAS (1989) and Rutherford et al. (1990) stress the need for reform. They believe that Project 2061 provides many good answers to some of the problems facing science education. The concluding theme is that in reform, only teachers can provide the insights that emerge from intensive, direct experience in the classroom itself.

There has been one movement that has greatly impacted deaf education. Related to the Least Restrictive Environment section of PL 94-142, the movement is marked by the "mainstreaming" of deaf students in public schools. Scruggs and Mastropieri (1994) investigated mainstreaming in elementary schools. They found that overall, the classrooms were successful. They list seven variables that were important: administrative support, support from special education personnel, positive classroom atmosphere, appropriate curriculum, effective general teaching strategies, peer assistance, and disability-specific teaching skills. The basic conclusion of the report was that "the present investigation provides important evidence regarding how students with disabilities are, or can be, included in science classes" (Scruggs and Mastropieri 1994).

Two other common reform positions, concerning science education, are based on two distinct philosophical and methodological camps- often referred to as positivists or postmoderns. Loving (1997) explores science education's journey through Positivist-Postmodern territory. The research seeks to justify the development of balanced views regarding the positivist-postmodern debate in science education. She was concerned that too few science educators are aware of the spectrum of current philosophies, their historical connections, and their answers to fundamental questions. The conclusion is that philosophical arguments are a necessary part of any discipline and that science teachers should strive for neutral ground, involving the best of various positions.

Keeping in mind Loving's (1997) points, we need to remember that what we have read is, regarding theories and reform, is only the tip of the iceberg of what is available for us to read. I have selected just a few samples that, in my opinion, reflect common themes or focuses in similar literature.

Problem Areas and Suggestions

Regarding science education, the problems that are most recurring in research literature can be grouped into the following categories: Resources, Gender differences, Teacher Preparation, Careers, and Language barriers.

Resources

Lang and Propp (1982) found that the resources available to the teacher of deaf students are often lacking in quality, or not even available. Funding and "red tape" are often cited as reasons why this happens. The textbooks are either too technical, beyond the scope of the deaf reader's ability, or too "dumbed-down" to be of any use.

Kahle (1994) cited the area of resources in science education as a persistent problem. The laboratories are often not available or have outdated technology, funds are not sufficient for field trips, and the materials for class are seriously deficient in information and accessibility.

Gender differences

Burkham, Lee, and Smerdon (1997) found that girls tend to focus more in life sciences while boys tend to focus more on physical sciences. They report that girls have the largest disadvantage in physical science achievement relative to their male counterparts. That discrepancy increases as the students move up in the educational system. Differences in cultural and social expectations, lack of participation, and fewer opportunities to learn are factors that contribute to gender differences.

Teacher Preparation

Lang and Propp (1982) found several problems related to the quality of teaching in classrooms with deaf students. Science teachers of the deaf often (1) have little or no training in their content area or with deaf students, (2) are not aware of several professional organizations that could help them, (3) are not certified, and (4) are dissatisfied with resources available for them to use. NSF/DOE (1980) findings also support the above study, citing the erosion of support groups for teachers as the biggest reason for the inability or effectiveness of teacher's work.

Careers

Lang, Albertini, Erickson, Robinson, and Mousley (1997) offers several reason why few young deaf men and women choose science as a career. These include (1) poor training of science teachers (more than eight out of ten science teachers had no degrees in science or science education), (2) lack of deaf role models in science, and (3) limited competency of deaf students with English. They also found that very few science teachers incorporate career awareness as part of their teaching.

Language Barriers

Lang and et al. (1997) state that a major predictor of success for deaf students in science education is competency in the English language. The research shows that deaf learners regularly process complex sentences as simple sentences which explain why misinterpretation of meaning and understanding of text is common.

All of these, indirectly, affect the quality of textbooks used in science courses. Keeping in mind these general problem areas, we now turn to the criteria used in evaluating textbooks.

Criteria Used in Evaluating Textbooks

Albertini and Lang (1995) state that words used frequently in the curriculum which are crucial to the subject being taught should be emphasized in some way. The article provides some guidelines as to what is preferred in terms of vocabulary choice and set up.

Dowabily (1995) investigated the use of adjunct, or follow-up, questions. He has found that the earlier and more often such questions are used throughout reading, the better understanding the reader tends to have of that material or subject.

Mahoney and Thomas (1989) state the importance of hands-on activities and the age of the textbooks. They recommend that the publication date for the books be no more than two years old.

Other research mentioned earlier will be considered with regard to what can be done to improve textbooks.

Methodology

A total of four schools are involved in this study. One residential school for deaf students and a public school from the state of New York and Pennsylvania. Textbooks from all junior and senior science classes from each school were collected and evaluated. In addition to the analyses, a survey was also given out to the teachers of these science classes, asking questions about the books they use. The criteria used for analyses are 1) the presence of vocabulary, 2) the use of adjunct questions, 3) incorporation of hands-on activities, and 4) the age of the book. I will construct a scale for evaluating the textbooks according to each of the four criteria. Please refer to the appendix at the end of the proposal to see an sample of the scaling used in evaluating textbooks. The data will be organized to show trends in terms of how the classrooms fare in terms of the quality of textbooks. In addition, the trends will be compared to the what the literature review states.

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Science Textbook Survey

Name of Textbook:
Author of the Textbook:
Date of Publication:

Scale: 1 2 3 4 5 6
Strongly Disagree ... Strongly Agree

Scale:	1	2	3	4	5	6
	Strongly Disagree					Strongly Agree

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1. The textbook is up-to-date? ___

2. The textbook meets the standards of your state and the National Science Education Standards? ___

3. The book encompasses skills of science? ___

4. The book will accommodate a diversity of learners? ___

5. The book contains relevant information? ___

6. Student activities in the book are appropriate and fun? ___

7. Safety is emphasized in the activities? ___

8. Reading level is appropriate? ___

9. Career information is provided in the book? ___

10. Supplemental teacher material is provided? ___

11. The illustrations clarify or complement the information in the book? ___

12. The book does a good job in integrating skills from other subject content, ex. Mathematics, history, etc? ___

13. The book is non-discriminatory and unbiased towards groups? ___

14. Vocabulary is presented and easy to understand? ___

15. You are satisfied with the book? ___

Continued on second page...

16. Who made the decision in selecting this textbook?

17. On what basis was this textbook selected?

Please write any additional comments you may have here.

Evaluation Form

Name of book:

Publisher: Edition: Year:

Grade used for:

Age of book

0	1
More than 3 years old	Less than 3 years old

comments:

Adjunct Questions

1	2	3	4	5
none	end of unit	end of ch.	2 or more per ch.	every sect.

comments:

Hands-on Activities

1	2	3	4	5
none	end of book	end of unit	end of ch.	every sect.

Average number per chapter? ____
Kinds of activities:

comments:

Presentation of Vocabulary

1	2	3
End of BOOK glossary	End of UNIT glossary	End of CHAPTER glossary

Highlighted? Bold? Italics? Other?

comments:

Related Technologies

CD-ROM?
Connection to the WEB?
Special equipment needed?
Supplementary items?