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Science Education

"Does Teaching Less Content Lead to Better Understanding?"

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Spring 2001.

Initially, in my personal opinion, I believe that teaching students less content in science in reasonable depths will result a great degree of understanding. Thus, in this paper, my hypothesis I would like to investigate is "***Does Teaching Less Content Lead To Better Understanding?***"

Looking at my research question, it consists of two important concepts. First, *less content* can be defined as a textbook that has few topics. These topics include the most important fundamental concepts on which teachers spend more time teaching each topic in reasonable depths. Second, I mean by *better understanding* students' ability to solve multistep problems, justify problems' solutions, explain the rationale of given concepts, and extend concepts to various situations in real life. Therefore, I am going to investigate students' understanding by using tests and individual interviews. Ultimately, my research question is important for teachers and students. For teachers, a textbook that has less content in science or mathematics helps deliver an effective teaching. Teachers have an opportunity to work equally with their students and engage them in solving problems and proof and reasoning. Teachers, with less content, have sufficient time to address all the concepts in depth rather than breadth. On the other hand, students will benefit from being taught less content, too. Less content gives students more space to learn and communicate with one another, and they do not feel the pressures of learning more than what they really need. Optimistically, I hope to find out why less content gives students opportunities to gain understandings and develop better attitudes toward their society.

From the previous concerns, I have been gone through different steps and activities that I engaged in to investigate this research question. I taught science and mathematics for one year in an elementary school, and taught an introductory of Zoology course in a teachers' college for a year in Saudi Arabia. Beside this experience, I consulted some academic professors in the school of education, Department of Curriculum & Instruction, science education to give me some ideas that can highlight my search. With regarding to the sources that I acquainted, I read several articles in both science and mathematics education. Reading additional articles is expected in order to gather more information about my research question. I read the following articles:

1. Flannery, M. C., Teaching Less Can Mean Better Teaching. In this article, the author revealed that the quality of science teaching was a concern in American public

schools. She suggested that teachers could increase the quality of science teaching by reducing the amount of material and teaching less science in schools. In addition to that, the author insisted that students must being prepared to assimilate and evaluate scientific information that they learned and apply the information in their societies.

2. DeBoer, G. E., What We Have Learned and Where We Are Headed: Lesson from The Sputnik Era. In his article, DeBoer discussed a reform movement in science and mathematics education in the United States that several years ago was a part of America's strong reaction to the Soviet Union satellite, Sputnik. He stated "science and mathematics content was badly out-of-date and tended to be presented in an encyclopedic format, as bits and pieces of information to be memorized, or computational skills to be mastered, without developing a sense of the relationships between broader ideas. The subjects were not presented as coherent, integrated, conceptual wholes but as collections of fragments" (DeBoer).
3. An article by the National Academy Press. Mathematics and Science Education Around the World: What Can We Learn? In this article, an important issue is discussed. That issue is: *A Question should be asked: Is Less Actually More?* The article explained the Study of Mathematics and Science Opportunities (SMSO), which showed that countries make various choices about how much time to spend on certain topics, and about how many topics to present at each grade.
4. Hofstein, A. & Yager, R. E. Societal Issues as Organizers for Science Education in the '80s. The authors talked about the importance of integrating social issues in science education, and how it would be helpful to build a strong foundation when students concentrate on social issues in their science, which will enable them to deal with such issues in the future. In addition, they did not ignore the need for or importance of scientific content, and stressed that the content should be studied superficially.
5. Kimpton, S. Scientific and Technology Literacy within Formal Schooling. In this article, the author said that the demands of changes no longer relies only on science mathematics content, but stress relevance to the society and begin with the concerns of societal issues. Also, he proposed that the current research point is constructivist theories, the "less means more concept," and the "literacy here is not simply reading and writing, but encompassing the interactions necessary with respect to science and

technology to be part of culture and to play an appropriate part in solving societal problems, making decisions and generally improving the quality of life" (Kimpton, 1998).

6. Standards 2000 Project. The Principles and Standards for School Mathematics 2000. The Standards recommend general principles to be achieved by students by the end of each grade level. One of the general principles is concentrating on reducing the amount of content, so students' learning will not be just a process of memorizing rules and concepts. Moreover, students will be able to gain knowledge by focusing on depth rather than breadth. The Standards also focus on the major roles of teachers in terms of carefully understanding the rational behind the scientific content.

From the result of my studying in the United States, it can be said that I had opportunities to acquaint more closely with different curricula. Some of these curricula have a huge amount of scientific content that must be addressed in a certain amount of time. In this situation, teachers will be under considerable pressures, and these pressures without doubt will push teachers to finish their courses whatever the results would be.

Having talked about my various experiences, activities, and articles, the discussion will turn to provide a brief review of some of the significant efforts in this area. The Sputnik Era in the 1957 was a turning point in American education. Huge numbers of curriculum reform movements had emerged to face such ascent, which was performed by the Soviet Union. Improving the academic achievement of all students was an important target of these reforms as well as teaching them to "think rationally, analytically, critically, and deeply about a subject … in mathematics and science" (Berman et al, 1995).

For the time being, a new idea, *Less Is More*, finds its way into most scientific and mathematical discussions. The National Academic Press (NAP) stated "Some of the current reforms in mathematics and science education are based on the idea that students will develop a deeper understanding if they study fewer topics in greater depth" (National Academy Press). In other words, as Duggan-Haas said, "teaching less content allows for better understanding and more meaningful applications" (Duggan-Haas, 1998). As a result, the "student will end up with richer insights and deeper undersigns than they hope to gain from a superficial topics" (Project 2061, 2000). In his article, DeBoer claimed, "Numerous attempts were made during this century to organize content into conceptually integrated packages that could be studied in

depth so as to avoid the fragmentation that results when facts and information are presented in encyclopedic fashion" (DeBoer, G.E.). Consequently, this new idea, less is more, has emerged to remedy the situation in which American schools find themselves. This idea is regarded as "the heart and soul of the current reforms" (Duggan-Haas, 1998) in both mathematics and science.

To support such an idea, teachers should not be asked to teach more content, but they should teach less content for the sake of better understanding. Meanwhile, teachers should be able to answer important questions: What should students know about, for example, science or mathematics when they finish the course? What concepts of mathematics or science should students focus on and be able to develop (Flannery, 1986)? To answer these questions, teachers must take society into consideration when attempting to select concentrated topics in terms of introducing some beneficial ideas in various contexts and extend them as the course progresses. For instance, in the 1960s, scientific content was regarded as a major goal. However, in the 1980s, scientific content was considered to be useful and relevant when it contributed to solve serious societal problems (Hofstein & Yager, 1982). It was obvious that concentrating on specific topics that are related to societal issues meant less is more. In addition, this "Less-Is-More" approach is followed today in programs such as Project 2061's *Science for All Americans* (DeBoer G. E.).

In supporting this notion, the Principles and Standards for School Mathematics insist on reducing the amount of content, so students' learning will not be just a process that simply relies on imitating memorizing rules and concepts. Furthermore, conceptual knowledge could be achieved by focusing on depth rather than breadth. Another important thing is that teachers need to carefully understand the rationale behind the scientific content for teaching and students' critical thinking (Principles and Standards for School Mathematics, 2000). So the processes of teaching should rely on conceptual thinking that may go with constructivism theory where teachers are regarded as "observer[s] and listener[s], rather than giver[s] of information" (Kimpton, 1998).

From the previous proposals, it is obvious that many curriculum reforms advocate the new approach "Less-Is-More". Therefore, I formulate the following research question: ***Does Teaching Less Content Lead To Better Understanding?***

Exploring the research question:

First, I will postulate an assumption, which is if I am able to obtain permission from the Human Subject Committee to implement my search, the following outline descriptions will be my approach to explore and investigate the research question.

Initially, It is impossible to investigate any research question without selecting appropriate theories and concepts. So it is important to me to take this issue into a consideration. A theory is simply means theoretical ideas and concepts from which any researcher works. The theory tries to create a reasonable connection between various concepts. Concepts are very important because they provide with general directions about what to look for, and they might be used to further information when data is collected. Therefore, theories and concepts can provide my research with general set of ideas that drive actions such as students' achievements.

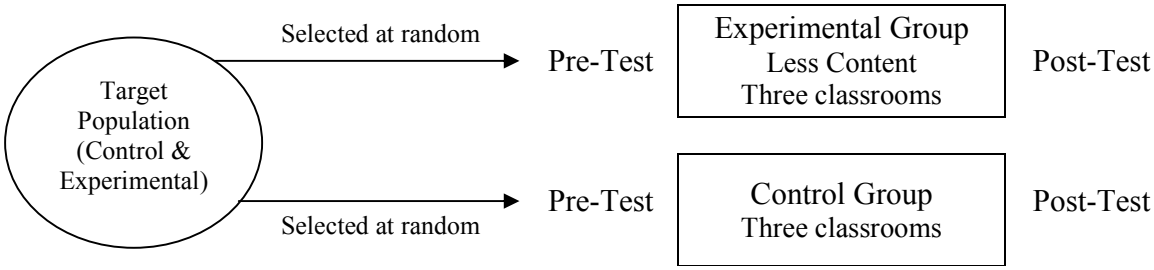
In general, the key concepts that I am going to focus on will be strictly relevant to my research question. They are: **Constructivism theory** refers to "a method or approach to teaching that learners construct their own knowledge" (Spafford et al, 1998). In other words, learners will build their individual knowledge throughout their own experiences; **critical thinking**, which refers to students abilities to think in logical reasoning; **better understanding**, which refers to the students abilities to apply what they have been studying to real world situations; and **less content** concentrating on few subject matters that lead students to develop better understanding. However, I will not be restricted to these key concepts. Therefore, supplementing new key concepts can be expected as I progress in my project.

In addition, when teachers use a constructivism approach to teach a textbook that has less content, they will give their students a chance to build their own knowledge, logical skills, and critical thinking by collaborative work, communication, and proof reasoning. For instance, when science teachers give a problem, students will spend sufficient time sharing and discussing the idea of the problem and trying to figure out possible solutions, and, then, connecting it to different situations. I assume that when students go through these learning processes they will develop better understanding. Because of that, I think these concepts are useful and appropriate to conduct an empirical study to address my question.

The Study Sample:

Having discussed the importance of theories and concepts, I am going to investigate my research question by using an *Experiment*. My study has two variables: Less content and better understanding. It also has experimental and control group. So I think the most appropriate methodology for my study is experimentation. The data collection method will be *Tests* (*Pre-test* & *Post-test*) and *Interviews*. The pre-test will be given at the beginning of the school year study and the post-test and interviews will be accomplished at the end of the school year study for 6th grade students in science classrooms.

The population of the study will be all 6th grade science classrooms in Monroe County elementary schools in Bloomington, Indiana. The study sample will be six science classrooms randomly selected from six different elementary schools. I will place schools' names in a box, mix them well, and draw out six names. Three of the schools will be the experimental group and the other three will be the control group. The sample will be representative of the population to ensure that the population has an equal chance of being selected. The main focus of investigation is students' understanding science in the 6th grade. Students' understanding will be determined by comparing the pre-test, post-test scores between experimental and control groups, and then interview analysis, using the Two-group design:



Having the control group will enable me to measure the effect of the treatment on students' understanding, then evaluate whether the difference between them is significant compared to what I would expect by chance.

Furthermore, there are some general considerations that should be taken into account. For instance, before the beginning of the school year, I will select a science textbook for experimental group, which is based on different criteria such as National Science Standards, containing less content, and applying constructivism approach, whereas the control group will

study the traditional science textbook, which is adapted by the school district curriculum committee. Both of the textbooks address the main basic concepts. The six classes will have the same number of periods per week. Teacher will follow the process of teaching recommended by his/her textbook. Another consideration is that at the beginning of the school year, I will apply the pre-test to the entire sample and save the scores in order to compare them with the post-test at the end of the school year. Comparing the two tests will show whether students' understanding improves or not. I, with the help of teachers, will prepare both tests. The purpose of the test is to measure students' understanding in light of explanation, inference, synthesis, and proof reasoning. Therefore, I think the appropriate type of test is multiple choices. The tests will contain 20 items addressing most main concepts. Since the tests are multiple choice, the chance of guessing is highly possible, so I will do interviews after giving the post-test to ensure that students' answers are based on understanding. As far the interviews, I will randomly select five students from each classroom (six classrooms = 30 students). The interviews will be interpreted on a 3-point scale: 1= *Sure with exploitation*, 2= *Just sure*, 3= *Not sure*. This scale will show me how many responses to the test items resulted from understanding, rather than chance. The interviews will be related to some of the tests questions. Students will be asked questions, for example, "explain how you chose answer A rather than B, C, and D"; "why did you eliminate these choices?"; and "how will you modify the wrong choices to be correct?" Also, I will completely rephrase some questions and ask students to answer them.

In this question, I will consider the following generalization issues:

1. **Validity:** In order for my study to be valid, there are three kinds of evidence that should be taken into account:
    a. Content Validity: When I design my tests, the tests will cover most concepts in both textbooks that students have studied in both groups. I will endeavor to consider "comprehensively, …, clarity of printing, size of type, adequacy of work space, …, appropriateness of language, and clarity of directions" (Fraenkel and Wallen, p. 171).
    b. Criterion Validity: I will be looking at the relationship between scores obtained by my instrument and the analysis of interviews. My instrument is

designed to measure students' understanding. High-scoring students in the post-test are expected to justify their answers during the interviews.

c. Construct Validity: The instrument's items are designed to measure students' understanding.

2. **Reliability:** I will compare the post-test result with the interviews results to ensure the consistency between them. I will obtain high reliability if the interviewees are able to rationalize their answers in the post-test. In other words, the post-test and the interviews are said to be convergent (Consistence).
3. **Generalizability:** I am concerned about generalization with respect to my findings for the following elements:
    a. Teachers' performance differs from one another, which may affect students' understanding and progress.
    b. Since the sample (Experimental and Control) is randomly selected, I will be able to generalize my findings in both cases, which are clarified in the next two elements.
    c. If the control group has higher scores than the experimental group, I basically fail to obtain what I have planned. In the future, I will look carefully for other factors related to my question.
    d. If the experimental group has higher scores than the control group, I can generalize my findings and recommend my findings to people who are in charge of education systems.
    e. If there is no difference between the two groups, again, I fail as stated in element C.

The following ETHICAL issues will be considered in my study:

1. I will submit a brief proposal to the human subject committee in order to obtain official permission. I will explain all the different steps and activities that I will engage in such as tests and interviews.
2. I will write a letter to the school districts asking for permission to conduct my study in their schools.
3. After choosing schools, I will ask the schools' principles for permission to conduct my study in their schools, too.

4. I will ask the schools' administrations to ask the 6th grade students parents for permission for their children to be involved in the study.
5. If less content fruitfully works, should not the control group get the treatment, too?

In conclusion, I think it is obvious how it is important to concentrate on few subject matters that contain understandable and reasonable depths. It is important both for teachers to deliver effective teaching and for students to involve in problem solving and proof reasoning by using their knowledge and experiences. Another major advantage of teaching less is the discovery strategy, which stimulates and activates students. Students are likely to attach more value to the task at hand because they have to exert more effort. Less content gives students more latitude to learn and communicate one another. This will make them more self-reliant because they will not feel the pressures of learning more than what they really need. Moreover, I believe that teaching less content expands the cognitive ability of students by developing the process of critical thinking to find alternative and creative solutions to problems. Students are better able to understand and solve problems and to identify and recognize underlying assumptions, basic concepts and applied ideas. Eventually, teaching less content provides a closer parallel to the way knowledge is gained and used in real life.

For the previous advantages, my decision about investigating this particular study would be ***YES***. Even though I will face many difficulties, I have a strong feeling to submit this research question as a proposal for my doctoral dissertation in science education at Indiana University. In fact, I really like this question because it will enable me to alter our education system especially in the Curriculum Development Administration in Saudi Arabia.

Reference

Berman, P., McLeod, B., Nelson, B., McLaughlin, B., Minicucci, C. Woodworth, K. (September, 1995). School Reform and Student Diversity. Volume 1. [Online]. (2001, April 1st). Available: http://www.ed.gov/pubs/SER/Diversity/title.html

DeBoer, G. E. (N.D.). What We Have Learned and Where We Are Headed: Lesson from The Sputnik Era. Colgate University. [Online]. (2001, April 1st). Available: http://www.nationalacademies.org/sputnik/deboer.doc

Duggan-Haas, D. A Proposed Introduction to the NSTA Standards for Science Teacher. Preparation. [Online]. (2001, April 15). Available: http://www.msu.edu/~dugganha/intro.htm

Flannery, M. C. (May 15, 1986). Teaching Less Can Mean Better Teaching. Journal of College Science Teaching. Vol. XV. (6). P.504/565-66.

Fraenkel, J. R. and Wallen, N. E. (August, 1999). How to Design and Evaluate Research in Education. 4th Edition. By McGraw-Hall Companies, Inc. USA. http://www.mhhe.com

Hofstein, A. & Yager, R. E. (November, 1982). Societal Issues as Organizers for Science Education in the '80s. School Science and Mathematics. Vol. 82. (7). P.539-47.

Kimpton, S. (June, 1996). Scientific and Technology Literacy within Formal Schooling. . [Online]. (2001, April 1st). Available: http://www.cant.ac.uk/depts/acad/teached/ICASE/ch0.htm

National Academy Press. (N.D.). Mathematics and Science Education Around the World: What Can We Learn? [Online]. (2001, April 1st). Available: http://www.nap.edu/html/timss/timss.pdf

Spafford, C. S., Pesce, A. J., & Grosser, G. S. (1998). The Cyclopedic Education Dictionary. International Thomson Publishing Company (Delmar Publishers).

Standards 2000 Project. The Principles and Standards for School Mathematics. (2000). [Online]. (2001, April 1st). Available: http://standards.nctm.org/document/chapter5/index.htm#TOP

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