Examining the obstacles and possible solutions for improving science education in Southern Mexico

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Abstract

The purpose of this qualitative study was to obtain a better understanding of the obstacles and possible solutions for improving science education in Southern México. It provides information about the challenges faced by teachers and school administrators, and possible alternatives for improving the quality of teaching after ten years of a curriculum reform. The researchers used an emergent design, with emphasis on the complexity and understanding of the conditions of teaching at the schools. Data were collected using multiple methods, including focus group interviews, observations, individual interviews, and document analysis. Five areas were identified for improving science education: student learning, curriculum content, student assessment, and teacher professional development, including preparation in the subject matter, constructivist teaching pedagogy.

Keywords: science teaching, evaluation, quality.

Introduction

One of the main indicators of the capacity of a nation for competing in the global market is the performance of its students in mathematics and sciences. The growing interdependence of the markets demands for a labor force with solid preparation in mathematics, language and communications, as well as more creative and flexible students, capable to work with others (Castro, Carnoy & Wolf, 2000).

In the case of Mexico, the interest for improving the quality of science teaching was consequence of the needs detected in the Third International Mathematics and Science Study (Peack, 1996; Peacock, 2000, Wang, 2003) conducted by the International Association for Student Assessment in 1993. In that study, Mexican students of elementary and secondary schools obtained lower achievement scores in mathematics and sciences when compared with their peers of other 40 countries. In average, Mexican students were 100 points below the world

mean. Among all, secondary students were the ones that obtained the lowest scores (Peack, 1996).

Given this situation, Mexico, like other nations began to make stronger efforts for improving the quality of science education and for reducing student dropout in this area. The National Program of Education (2001-2006), states policies aimed to improve student achievement in science such as, the review of curriculum contents, articulation between levels of education, the use of teaching strategies that favor the application of knowledge and problem solving. In addition, the government through a new National Institute for Assessment in Education began to evaluate school performance and conduct a follow-up of their advance, create accountability policies, and provide support for teacher professional development (National Program of Education, 2001-2006).

Because of the little research about the benefits of the policies for improving the quality of teaching in secondary schools, this study focused on examining critical issues about the quality of science teaching in public secondary schools in southern Mexico. The research identified the challenges faced for teachers and administrators, and the possible alternatives for improving the quality of teaching.

Methodology

This was a qualitative study that involved different stakeholders for understanding the quality of teaching in secondary schools in Mexico. A qualitative design was selected because as Stake (1994) states, this type of studies are especially useful for "refining theories and identifying critical issues for further research, as well as for establishing the limits of generalizations (p. 245). In addition, the design was appropriate because of its advantages for studying processes, relationships, contexts and situations, and provides a clear vision that help us to "identify problems, clarify and understand complexities and develop theories" (Peshkin, 1993, p. 24).

Fieldwork was conducted in a sample of public secondary schools in the southeast of Mexico that were implementing the curriculum reform of 1993, aimed to improving the quality of teaching in Mexican schools. As with most qualitative studies, the schools were not selected as a representative sample of all schools in the country, but on the basis of what schools could allow us to better understand the problems and challenges faced by different stakeholders.

Data collection involved document analysis, site visits and qualitative interviews. The researchers conducted focus group interviews with mathematics and science teachers, and in-depth interviews with principals, officials at the State Department of Education, the Head of the Normal School, and professional development staff in math and sciences. Site visits allowed for a better understanding of the conditions for teaching and learning.

The researchers used traditional means for validating their observations. The use of multiple methods of data collection, such as interviews, observations and document analysis, helped to triangulate the findings from different sources of data. In addition, the use of research teams and member checking helped to verify the precision of quotations and descriptions, and added to the validity of interpretations.

The methodology selected was consistent with the cultural characteristics of the participants, because as O'Rourke (1997) states, qualitative interviews are more valuable than surveys and other methods of data collection when working with Hispanics because of the personal nature of the relations within this culture.

Findings

Most teachers, administrators, Department of Education officers have a highly positive perception of the educational reform initiated in 1993 that resulted on curriculum changes and the adoption of a constructivist approach for teaching mathematics and sciences. The different stakeholders also identified important issues for improving science education:

- Even though the reform pretended to decentralize education, the curriculum was developed at the central offices of the Mexican Department of Education. Teachers are only allowed to decide what teaching strategies they can use for implementing the curriculum.
- There was disagreement among teachers about the possibilities of accomplishing the expectations of the reform given the time allocated for covering the content in the programs. Math instructors stated not having problems with covering the contents because the reform increased the number of hours for teaching mathematics. Biology, Chemistry and Physics teachers have problems trying to complete their courses

because the curriculum content increased, but the time allocated for these courses was significantly reduced.

- There are sequence problems in the curriculum programs. This is evident in the case of Biology I, in which some prerequisite knowledge is missing, but it is included in Biology II.
- It needs to be a better articulation between educational levels. Elementary schools promote memorization and are not providing prior knowledge required for the next level of education.
- There is a lack of resources, particularly on the rural areas where teachers do not have adequate facilities for teaching students who work full time in addition to attending school. In some schools, electric facilities are not appropriate for the newly acquired computers.
- Teachers and principals were concerned that the changes in the grading system and strategies for reducing student dropout rates were promoting negative attitudes among students, who are more interested on "playing to the numbers." Administrators also stated to be under pressure for not failing students in order to reduce student dropout rates.
- Different stakeholders indicated that the delay in the delivery of textbooks and other curriculum materials from the Department of Education, the limited resources and the inadequate facilities were affecting negatively the implementation of the curriculum.
- The participants also indicated that the increase of divorce rates, the lack of supervision of students after classes, as well as the negative influence of the media were also influencing the low achievement of students and increasing problems such as teenage pregnancy, drug and alcohol abuse and gang formation.
- According to administrators, the most important problems were the negative attitude of teachers toward change and professional development.
- Teachers stated that some administrators do not support the implementation of changes in the classroom because they are concerned with discipline disruptions. Since most administrators are not prepared in constructive teaching, they do not understand what is needed for implementing this kind of teaching.

- According to teachers, one of the main obstacles for professional development is the decision of hiring most science teachers on an hourly-basis. As a result of this situation, teachers have to work in more than one school, interfering with their possibilities of professional development.
- Another factor influencing teacher participation in professional development activities was the little relation of these activities with teacher needs, the context of teaching, and their participation in the process of planning, developing and evaluating the professional development activities.
- Teachers need to improve their preparation in the subject matter as well as their pedagogical skills for teaching science.

In addition, to improve the quality of teacher professional development in mathematics and sciences, the different stakeholders made proposals for improving the quality of teaching:

- Give teachers the opportunity to adapt curriculum contents and participate in the development of curriculum plans. The selection of curriculum experts at the central level is important but is also important to include those who are more aware of the conditions and the context of teaching when making curriculum changes.
- Increase the number of hours that students remain in the school. Currently, students attend the school from 7 a.m. to 1 p.m. In this way they will be able to work on their assignments at the school under the supervision of a teacher assistant. Since the Department of Education has not provided funding for increasing teacher salaries, students from the Normal schools and other institutions preparing science educators could be the teachers supervising these activities, in this way they will have an opportunity to realize their professional practices while helping students to learn.
- Create a tutoring program to help students to develop their reading and writing and critical thinking skills, as well as their abilities for searching and using scientific information.
- To include a variety of assessment techniques in addition to the tests, this will provide a better spectrum of student learning and correct the problems of the changes in the grading system.

- It is necessary more investment on equipment and materials for teaching science in the schools. The Department of Education at the state level could also develop partnerships with the public universities to have students and teachers access to libraries, and teaching materials for science. These partnerships could also work for creating professional development opportunities for teachers, particularly those hired on an hourly basis.
- Hiring a school psychologist to address growing problems among students, such as teenage pregnancy, drug and alcohol use, as well as gang formation.

Conclusions

Based on the findings, there are five areas in which the quality of science can be improved: student learning, curriculum content, student assessment, and teacher professional development, including preparation in the subject matter, and constructivist teaching pedagogy.

Findings of this study were consistent with the literature on teacher professional development which states that that teacher professional development is one of the main factors influencing student learning (Laurer, 2001). The results were also consistent with the work of Rivaud (2000) and Fuenlabrada (2000), particularly in relation to the need to improve the pedagogical preparation of teachers. The study, however, found that in addition to pedagogy, teachers need to improve their knowledge of the subject matter. Some teachers also stated that they would like to receive preparation on how to teach adolescents as well as how to improve the relationship between home and school.

The research findings were also consistent with the work of Peña y Salazar (2004), who found that all effort for the preparation of teachers should take into consideration not only the context of the schools but also to actively involve teachers. Base on the findings, it is necessary to develop projects to improve teacher preparation in mathematics and sciences, primarily on the subject matter and constructivist pedagogy.

It is important to note that as a result of the study, more data collection is being implemented to identify in what content areas there is a higher need for preparing teachers. The results of this part of the research will be used for developing a teacher preparation program for science educators in the southeast of Mexico. The new project will use the framework of communities of practice (Lave & Wenger, 1991), in the development, implementation and

evaluation of a program for teacher innovation in science. The framework of Communities of Practice has been effective in the creation and development of communities among different professionals (Lathlean & Le May, 2000; Plaskoff, Lilly et al., 2003; Somekh & Pearson, 2002).

Importance of the study

The study is relevant for Mexican institutions focused on improving secondary education and for its future impact on higher education, as well as for the US schools in the case of reverse migration. In addition, the topic is of importance for both nations as there are the issues of equity and ethical concerns, primarily in the case of rural schools. Because Mexico is also one of the countries that provide the United States with a significant number of immigrants, further studies could look at the profound implications for the delivery of educational services for these children (Chapa & Valencia, 1993).

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