

A Model to Develop Mathematics Education: Modify the Public Traditional Perceptions of Mathematics-Case of UAE Schools' Principals

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Abstract

This paper addresses the idea that the successful of mathematics reform demands the support of the full educational community including school principals, parents, and students. One of the most important group that affect mathematics reform is school principals. A project related to modifying UAE principals' perceptions of mathematics is presented. This project consists three steps. In the first step, principals' perceptions of the nature of Mathematics and its learning and teaching were examined. Results showed that those principals possess many improper perceptions related to Mathematics. In the second step, a professional training program for promoting school principals' understanding of the new vision of teaching and learning mathematics has developed. This training program comprises two integrated phases: Clarification and conviction, and implementations for principal's role. It includes a package of paper documents, videotapes, discussion sessions, and group and individual activities. In the third step, the training program is applied on eight principals in UAE. An initial analysis of the qualitative data showed many positive improvements in principals' perceptions of mathematics education.

Introduction

This paper based on the idea that the educational community's awareness and understanding of the new vision of teaching and learning mathematics is a necessary condition for mathematics reform. Without this condition, all the efforts in changing mathematics curricula and training mathematics teachers will not be fruitful. We assume that the way *people* see and perceive mathematics, affects the processes of teaching and learning mathematics. In this context, the word *people* does not mean just the teachers and supervisors of mathematics, but it also means all the educational community including parents, students, principals, administrators, and the other subjects teachers.

Apparently, there is a common public way in viewing the subject of mathematics. Unfortunately, most of the ideas of the public view contradict the real nature of mathematics. Such ideas as: mathematics is abstract, it is difficult, for boys more than for girls, just for clever people, it is a collection of fixed theories and rules, unchangeable facts, a tool for computations. Similar views about teaching and learning mathematics are held by the public; such as: facts should be taught first then the applications and problems, learning mathematics is a combination of a series of facts and mastery of procedural steps, always one specific right answer should be their. (Oster, Graudgenett, & McGlamery, 1999). It is assumed that as long as those perceptions about mathematics are spread within the educational community, mathematics reform is facing considerable difficulties that might affected negatively. To clarify this point lets for example consider a situation in which the parents believe that their children are doing great in math because they can do all the computations quickly and precisely, or that their kids are poor in mathematics because they cannot do that. Let's also consider the situation where the principals expect from mathematics teacher to cover the textbook in order, step by step, and facts and knowledge should be provided first. In such situations we can conclude that the monitoring and assessment processes of teaching and learning mathematics will not be consistent with the new vision of Mathematics reform that sees Mathematics as a tool of thinking and communication and not as a accumulation of computations and procedures.

Principals Group

One of the most important groups that effect mathematics reform is the "school principals" group (NAESP, 2002). Assuming that perceptions affect people behaviors (Bandura, 1997), principals' perceptions regarding the new vision of Mathematics Education might significantly affect mathematics reform efforts (Lester & Grant, 2001; Spillane & Halverson, 1998; Heck, Banilower, Weiss, & Rosenberg, 2008; Sassi, 2007; Hansen & Mathern, 2008; Williams, Tabernik, & Krivak, 2009).

Teaching Mathematics according to the new vision is facing many challenges. Teachers are challenged to provide opportunities and experiences that allow students to build their own mathematics. This requires a deeper understanding of the mathematical content than that developed by the traditional teaching methods. This also requires more time, conditions, and requirements (McDuffie & Graeber,

2003). Researchers found that, during the process of changing to reform-based approaches, teachers are likely to feel anxiety and frustrated (Campbell & White, 1997). To meet these challenges, teachers defiantly need support. Without support, these feelings may cause teachers to return to more stable and comfortable, traditional, practices; but with continued support, successful implementation of reform movement goals is more likely (McDuffie & Graeber, 2003).

Talking about support, it seems that the school principal is an important supporter. Principals can profoundly influence teachers who are working to change the ways they teach mathematics. Brown and Smith, 1997, showed that teachers were concerned about their administrators' opinions and needed to know that the administrators understood reform-based approaches. Principals' actions also are needed to provide both pressure and support for change and time to plan and implement new strategies.

Research Project

United Arab Emirates has been active in mathematics reform over the last 8 years. A determined national effort to reform mathematics education has been underway since the publication of mathematics curriculum outlines in 2001 (MOEU, 2001). Within the frame of this reform and based on the previous section, a research project that contains three steps is presented in the following:

First Step

In order to understand how schools' principals in UAE perceive the principles and standards that the new mathematics curricula is based on, a study was conducted by Innabi (2006). Responses from 244 school principals from all over the country were analyzed using an instrument prepared particularly for the study. The instrument was based on the standards that the Ministry of Education is adopting for teaching mathematics. Results showed that principals possess many wrong perceptions, such as:

- Mathematics is just computation that based on training and practicing.
- Mathematics is only for elite people.
- Math is a set of absolute truths that cannot be changed.
- It is a subject that always has right or wrong answers.
- It is not suitable to teach statistics and probability for the elementary stage.
- Problem solving is a verbal problem that comes as application at the end of the lesson.

These results indicated a need to help schools' principals in UAE to modify their view of mathematics to fit with the new vision.

Second Step

Based on the results of the previous study, a professional training program for promoting the elementary school principals' understanding of the new vision of teaching and learning mathematics has developed.

Two major principles underline the development of the program. The first is related to the conceptions of teaching and learning Mathematics that principals should possess. The other is the nature of the general strategy that has been adopted to help principals to modify their misunderstandings and misconceptions of the real nature of mathematics and its teaching and learning.

Regarding the first principle, the identification of conceptions of the new vision of teaching and learning mathematics targeted by the program were guided, in one hand, by UAE national standards for school mathematics (MOEU, 2001), on the other hand, by indicators gained from the previous study that mentioned before (Innabi, 2006) which examined the current conceptions of UAE principals of teaching and learning mathematics. The most wrong perceptions were found in nine aspects. These aspects were categorized in four categories; these are: nature of Mathematics, learning of Mathematics, teaching of Mathematics, and Mathematics curricula.

Table 1 shows these wrong perceptions within each category and brief descriptions of the desired conceptions as driven from the UAE national and international standards (MOEU, 2001; NCTM, 2000). The construction of the program is guided by the constructivism theory- assimilation /reconstruction model. This method based on the following three movements:

1. Targeted person (principal in this case) will be asked to express her/his opinion or understanding or perception about a specific point. The aim in this step is to help the participant to see her/his own perception.
2. Several situations that propose alternative perceptions that reflect the real and right picture of mathematics will be presented to participants. The aim of this step is to give participant the chance to compare, reflect on their own perceptions and to modify it.

3. Discussions and reflections processes to promote perceptions.

The training activities was developed with the purpose of enhancing principals' understanding of (1) Nature of Mathematics (2) Learning of Mathematics (3) Teaching of Mathematics. The program combines 10 focused groups' sessions; the duration of each section is two hours. Two sessions discuss the nature of mathematics, five sessions discuss the nature of teaching and learning mathematics, and three sessions discuss the role of school principals to support the new vision of mathematics. The program includes a package of paper documents, videotapes, discussion sessions, and group and individual activities. This program was built to be administrated in two integrated phases:

Phase 1: Clarification and Conviction

The nine points that were clarified in Table 1 were covered by using different activities such as: view and discuss videotapes of mathematics classes, explore student thinking through an examination of students work, read and discuss articles that provoke thinking about mathematics, engage in mathematics explorations and discussions. Figure 1 illustrates an example of the activities of this phase.

Phase 2: Implementations for principal's Role

During and after the activities and the discussions in phase one, the training program concludes implementations for principals role. In particular an answer will be provided at the end of the program to the following question: what principal can practically do for Mathematics reform regarding the following aspects: Supervising and evaluating teachers, professional development for teachers, communicating with parents & outside community, guiding and supporting school improvement efforts.

Table 1: Principals' perceptions of Mathematics

Wrong perceptions (found among UAE school principals)	Category	Real perceptions (that the program aims to achieve)
<p>Mathematics is fixed unchangeable facts that should be accepted.</p> <p>To be good in Mathematics, one should have Mathematics talent and aptitude</p>	Nature of Mathematics	<p>Mathematics is a growing science that develops with industrial and technological advances; it is not a settled and unchangeable knowledge but any mathematical knowledge could be changed if contexts and axioms are changed. Mathematics is not a collection of some theories, procedures, and rules but it is a way of thinking that inquires, analyze and understand patterns and order. Mathematics is not a collection of vague symbols and rules that just elite and smart people can understand but it is a thinking and communication tool for all.</p>
<p>Learning mathematics is based on training and practicing,</p> <p>The most important indicator of students' learning in Mathematics is achieving the right answers</p>	Learning of Mathematics	<p>Learning mathematics should be based on understanding and not on repetition and training.</p> <p>Achieving the right answer is not necessary the evidence on students' learning.</p> <p>All students can and should learn mathematics in a meaningful way based on understanding.</p>
<p>Problem solving is a verbal problem that comes as application at the end of the lesson.</p> <p>Students sharing in solving problems could be negative as errors of some students could affect the other students.</p>	Teaching of Mathematics	<p>Teaching mathematics has to base on problem solving. Problem solving is not a verbal problem that comes at the end of lessons as application. It is unfamiliar situation that challenge the student and this makes learning happen.</p> <p>Communication is a very important standard that should be considered in teaching mathematics where students have to be encouraged to express their thinking verbally and written with each other and with teacher.</p>

<p>Mathematics curriculum is a collection of concepts, skills and algorithms,</p> <p>It is not suitable to teach statistics and probability for the elementary stage</p> <p>It is not suitable to contain all sorts of mathematical content in every single grade</p>	<p>Mathematics Curricula</p>	<p>Mathematics curriculum is more than a collection of activities. It must be coherent, focused on important mathematics, and well articulated across the grades.</p> <p>In order to learn mathematics with understanding all sort of content (number, algebra, geometry, measurement, data and probability) should be included in each grade.</p>
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Example 1:

The target of the activity: *Achieving the right answer is not necessary the evidence on students' learning.*

Context: Division lesson for grade 4

Question to be discussed with participants: How do you judge students' learning of this lesson?

(All answers will be written on board).

A video clip will be presented and discussed: the video contains two parts. The first part shows a forth grade student who solve- using the paper and pencil- a division problem that request dividing 20 by 5. Student here can solve the problem rightly and confidently. In the second part this student will be asked to explain what she just did using a set of cubes. It will be notice that this student fall to achieve this task.

Discussion: What this can tell you?

Example 2:

The target of the activity: *Mathematics is a growing science; it is not a settled and unchangeable.*

Mathematics is not a collection of some theories, procedures, and rules but it is a way of thinking that inquire, analyze and understand patterns and order.

Context: Brain storming session

Question to be discussed with participants: what come to your mind when you hear the word "Mathematics".

All answers will be written on board, then categorized and summarized.

It is expected that participants will provide answers related to the nature of mathematics, its utility, their dispositions toward it,....

The discussion will be followed by providing examples (pictures, problems, facts from mathematics history) to show the real picture of Mathematics.

Fig. 1: Examples of phase 1 activities.

The target of the activity: *principals to be aware of the actions that they can do in their schools to be in line with the real view of mathematics.*

Context: this activity will be applied during conducting the program starting from the first session.

Principals will be asked to record all actions that they can do to support the real vision of mathematics.

A board will be assigned for this activity so principals can add their suggestions as follows.

<u>What can I do regarding this?</u>			
<u>1st session</u>	<u>2nd session</u>	<u>3rd session</u>
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A discussion session will be conducted at the end of the program to categorize the suggestions in order to be distributed to participants.

Fig. 2: An example of phase 2 activities

Third Step

In April 2009, this program was applied on 8 elementary school principals in Alain city in UAE. The purpose of this application is to examine the effectiveness of the suggested training program on the principals understanding of the new vision of school mathematics. The following procedures were applied:

1. Pre monitoring: the perceptions of participated principals were determined by using two tools ; principals' perception scale, and semi-structured interview.
2. Implementing the program.
3. On going monitoring: by observations, analyzing documents.
4. Post monitoring: to determine the improvement in principals' perceptions. Same tools of pre monitoring stage were used.

The analysis of the qualitative data that has been collected from this training program is still under process. However, the general observations and impressions before, during and after applying this program are reflecting a very bright picture of changes happened in principals understanding of the nature of mathematics and the nature of its learning and teaching, and most importantly, the nature of their role to help mathematics reform.

It is hoped that this project will present a useful training program for schools' principals to change their misconceptions of the nature of Mathematics and about its teaching and learning. It is also hoped that this paper will get the attention of the issue related to the public perceptions of Mathematics that could affect mathematics reform efforts.

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