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Implementing the intended mathematics curriculum: Teachers' beliefs about the meaning and relevance of problem solving:

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Abstract: The Malaysian secondary school mathematics curriculum is based on the constructivist approach. For effective implementation it is indispensable that teachers are not only aware of what the goals of the curriculum are, but at the same time cognizant of the underlying theoretical assumptions embedded in the curriculum. Recent surveys have however revealed that the most significant factors that tend to impede successful implementation are those related to teachers' beliefs about teaching and learning. Thus the question of how their beliefs differ from those of the curriculum developers is an important one. The study attempts to discover the differences between teachers' assumptions about teaching and learning, particularly related to problem solving in mathematics, as compared to those espoused by the curriculum. Data were collected from interviews, classroom observations and content analyses. The nature of mathematical knowledge transmitted, students and teachers activities were used as the orienteering constructs. These were then analyzed to identify teacher's assumptions about teaching and learning, particularly those related to problem solving. Initial findings indicate that majority teacher's beliefs are still traditional in nature despite various attempts by the Curriculum Development Center of the Ministry of Education to change teacher's beliefs about teaching and learning.

Background

During the last five decades, the Malaysian secondary school mathematics curriculum has undergone several significant changes. The traditional approach that emphasized on the attainment of skills was replaced by the modern approach in the 70's. In the late 80's as part of the nation-wide curriculum reform based on the National Philosophy of Education, the school curriculum experienced another change (Asiah Abu Samah, 1982). The changes have strong influence on the teaching and learning processes and consequently challenge the current assumptions about teaching and learning. It is necessary that we make the "psychological paradigmatic" shifts so that we could cope with the demands of educational change (Noor Azlan Ahmad Zanzali, 1996). Innovatory programmes will inevitably challenge current practices and thinking, particularly on our perceptions about knowledge, about teachers' work and professionalism. In addition, we need to realise that teaching and learning occur in a social context (Popkewitz, Tabachnick and Wehlage, 1977; Stephens, 1982; National Council of Teachers of Mathematics, 1989; Romberg, 1992). In recent years, the constructivist learning theory has started to influence education, particularly in the teaching and learning processes. Learning is seen as intergrated process. Children not only actively construct knowledge but at the same time these processes should happen in an intergrated and holistic fashion (Nik Aziz Nik PA, 1996). The social context in which learning and teaching occurs becomes vital.

The need to understand the implementation of the mathematics curriculum is important for two reasons. First, there is the need to continuously study curriculum implementation in the local context. This study was undertaken with the conviction that a study of the of the actual practices of Malaysian mathematics teachers would provide the country's developers with insights that would help them in formulating effective future curriculum innovations. Second, implementation data is often associated with the high rate of adoption (such the purchase of new materials) by schools and the results of the nation-wide examinations. These indicators, however, only provide surface information about the teaching and learning of school mathematics; they do not penetrate the rhetoric of educational discourse**.**

The integrated curriculum (KBSM)

The integrated curriculum (commonly referred to as KBSM) began to be implemented in the late 80's replacing the modern mathematics program. This curriculum is based on the belief that mathematics is a dynamic subject, coherently connected within itself and with almost all other areas of study, and that the main purpose of its study is to solve problems. The curriculum emphasises the importance of problem solving. Teaching should also emphasize context (either social or mathematical), meaning and the culture. In addition, the subject matter has rich historical backgrounds and its discovery is in response to human problems. (Pusat Perkembangunan Kurikulum, 2000).

Psychological perspective From the psychology of learning viewpoint, KBSM, in general, is mainly based on the constructive view of learning. It is important that students understand concepts in context

and that this understanding is constructed by the students themselves; as opposed to being transmitted by the teachers. The main aim of teaching is to create a meaningful learning environment such that students enjoy and yet find learning a challenging experience. For example, learning the basic number facts as an end to itself should not be encouraged. The basic multiplication should be constantly related to everyday living experiences. The students are to be engaged in solving problems (related to everyday experiences). Recommended activities that provide opportunities for students to construct their own knowledge is quite evident in the curriculum.

Pedagogical implications From the pedagogical perspective, KBSM emphasised that the teaching approach should take into consideration the integration in the following aspects:

1) learning and teaching materials
2) within and between subjects in the curriculum.
3) between theoretical consideration and practical applications.
4) between curriculum and co-curriculum activities.
5) between classroom and outside classroom activities.
6) between teaching strategies and learning styles.

Besides these, teaching should at the same time instil values and norms conforming to the aspirations of the National Philosophy of Education.

Implications on teaching The quality of teaching lies in the ability of the teacher to transform the knowledge (subject matter) in the form that can be understood by the learners (Fernstemacher, 1986). These should be done through activities that give ample opportunities for students to construct their own knowledge. Another important dimension of teaching often ignored by curriculum developers is that teaching can also be seen as a social process. Schooling is basically a collective experience. For the child it means that he/she is in a crowd. For the teacher it means that he/she has to control crowds and not separate individuals.

Successful implementation of the curriculum will depend heavily on the ability of teachers to transform the aspiration of the curriculum developers into form that can be accepted and understood by the students. Teachers should be able to understand and appreciate the changes that the curriculum is attempting to implement and not otherwise. Teacher training institutions, among other things, should endeavour to prepare teachers who will be able to handle changes in the curriculum (Noor Azlan, 1995).

Often, the new curriculum will attempt to introduce significant changes in the practice of teaching. To convey knowledge about curricular changes seen as paradigmatic changes in the philosophy and aims of education should be an important component in teacher development program. Educators should not only provide teachers with the necessary procedural skills, but also more importantly, attempt to understand and thus change the present assumption on teaching and learning mathematics. This research is part of the attempt to identify those assumptions that may impede successful implementation.

Research Objectives

The overall framework of the curriculum gives emphasis on the attainment of problem solving skills through constructive activities. Numerous programmes, course and workshops have been conducted to educate teachers and to equip teachers with the necessary skills and knowledge needed to effectively implement he aspirations of the curriculum. Thus it is reasonable to conduct research in order to ascertain:

1) Teachers interpretation of the meaning and significance of problem solving in the teaching and learning of mathematics
2) The constraints that teachers face in implementing the aspirations of the curriculum.

Research methodology

The research was particularly interested to look at how teachers interpret the demands of the curriculum, particularly those related to problem solving. Qualitative approach, conducted in the following sequence was used:

i) Content analysis of the syllabus, supporting materials,
ii) Pre-interview of some selected teachers,
iii) Classroom observations of the selected teachers, and
iv) Final interview of the teachers.

Content analysis was used as a way to gauge the emphasis given to problem solving in the curriculum. The pre-interviews were used to assess teachers' knowledge on teaching particularly those related to pedagogy.

This is then followed by classroom observations to ascertain how far their knowledge is consistent with their practice. Final interviews were then conducted in order to elicit the reflection of the teachers concerning their classroom teaching that have been observed.

The classroom observation scheme developed by Zulkifli Mohamed (1996) was used in the study. The final interviews, mainly based on the teachers' responses in the pre-interviews, were aimed at extracting information regarding the thought processes involved in certain pedagogical decisions that teachers were observed making in their classrooms.

Results and discussions

At this initial stage of analyses several features can be seen to emerge. These consist of two main types; the overall teaching approach and those particularly related to problem solving.

1) Mathematical content perspective

Through interviews and observations it is clear that teachers stick to the traditional belief that students' task is to get answers from clearly defined exercises. Problems situations that may lead to varied answers is not seen to be "good" mathematical problems. Further in-depth interviews reveal that this approach is embedded in traditional beliefs in the nature of learning in general and those related to problem solving in particular. Solving routine problems repeatedly is the best approach to learn mathematics. Related to this findings are two observations:

a) The influence of the examination in defining what and how to teach mathematics
b) Little ownership of the mathematical content of the curriculum among the teachers and thus they treat it as beyond their control to adapt and modify.

Both these observations serve to explain the reasons why the teaching approach were used by teachers. A bigger concern is however, these traditional beliefs about teaching student on how to solve problems are in conflict with those intended by the curriculum. Whatever initial aspirations the teacher had that are parallel to the demands of the curriculum are often subdued by the practical demands of the workplace.

2) Pedagogical perspective

The data indicates that majority of the teachers were more concerned with classroom management as compared to pedagogical or instructional considerations. There seems to be very low level of tolerance towards noise and slight disorders are frowned upon. Students are expected to be seated in orderly fashion focusing their attention on what the teacher is saying. Such a rigid learning environment is not conducive in promoting learning as envisaged by the curriculum. There is not much room for the students to explore, discuss and make conjectures on the problem solving tasks given to them. These activities are vital in enhancing problem solving skills among the students. Further interviews indicated that most teachers began to accept this as the norm and thus assimilate into their belief system. In most cases management considerations overshadow instructional priorities.

3) Teachers' Perspectives

In general the data indicate several categories of teachers:

1. Teachers who are knowledgeable about the demands associated with teaching problem solving. This group of teachers make significant efforts to implement what is expected from the curriculum and to a certain extent succeed in doing so.
2. Teachers who are knowledgeable about problem solving, but could hardly implement what they believe in due to constraints in the schooling system
3. Teachers who are unaware of the pedagogical implications on the problem solving approach in teaching and insist on defending their positions that the best way to learn mathematics is to repeatedly doing the routine problems.
4. A minority group belong to those who seem lost with the recent development on the pedagogical approach related to the teaching and learning of mathematics. These teachers insist on doing their traditional ways with no regard for the new demands of the curriculum. It has, from what can be concluded from the data, embedded in their beliefs about problem solving approach in teaching mathematics.

The above assertions may paint pessimistic picture on the Malaysian mathematics teachers. This, however, is not the intent. While teachers maybe knowledgeable and dedicated to implement the curriculum aspirations, working conditions and the daily routine faced by these teachers have shaped their beliefs on the significance of teaching problem solving so as to be in consistent with recent theoretical development in the teaching and learning mathematics.

In addition to the above, the research was also interested to penetrate teachers' beliefs about the learning process. The findings may be similar in other systems or situations, but the assumptions that teachers develop as they experience the routine nature of teaching is not. These assumptions need to be further identified and analysed.

Summary and conclusions

In general, the constructive nature of learning mathematics inherent in the curriculum is not reflected in classroom teaching. The more predominant "absolutist" assumptions of mathematics have controlled the process of teaching and learning mathematics in the classrooms. To know mathematics from the constructivist perspective is being able "to do" mathematics. Students need to recognize "the process of mathematical thought" and not just knowing the "mathematical product" (Skemp, 1979).

The development and implementation of any curriculum will affect teachers in significant ways and if teachers are not helped in coping with demands brought about by changes in the content, pedagogical and psychological considerations, the implementing process will not be effective. We argue that the curricular changes that have occurred within the last couple of decades cannot be looked at superficially. It involves deep-rooted paradigmatic psychological and philosophical changes.

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