STUDENTS' VIEWS AND ATTITUDES TOWARDS MATHEMATICS TEACHING
AND LEARNING: A CASE STUDY OF A CURRICULUM EXPERIENCE

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This paper describes a qualitative study dealing with the views about teaching and learning mathematics held by the students of a school involved in an experience of new curricula, stressing active methodologies and group work. At 7th grade, the students clearly noticed important differences in the mathematics classes and welcomed them. At 10th grade, they had a general positive attitude towards mathematics but did not perceive major changes. However, they were very concerned with the implications of this experience for their academic progression.

What views hold secondary school students regarding the teaching of mathematics? In what ways are these affected by a process of curriculum change mandated by the Ministry of Education? Are they sensitive to differences between old and new curriculum orientations? How does that influence their learning experiences?

These were some of the questions that we regarded as potentially interesting when we were asked by a Government agency to make a case study of a school participating in an experience of new mathematics curricula. Our work concerned a wide range of issues, including the nature of the innovation process and the perceptions of the participating teachers (see Ponte et al., 1991). In this paper we focus particularly on the views and attitudes held by the 7th and 10th grade students about teaching and learning mathematics.

Students' Views About Mathematics and Mathematics Teaching

The conceptions, attitudes, and expectations of the students regarding mathematics and mathematics teaching have been considered to be very significant factor underlying their school experience and achievement (Borasi, 1990; Schoenfeld, 1985).

The general conceptions determine the way students approach mathematics tasks, in many cases leading them into nonproductive paths. Students have been found to hold a strong procedural and rule-oriented view of mathematics and to assume that mathematical questions should be quickly solvable in

just a few steps, the goal just being to get "right answers". For them, the role of the student is to receive mathematical knowledge and to be able to demonstrate so the role of the teacher is to transmit this knowledge and to ascertain that students acquired it (Frank, 1988).

Such conceptions may prevent the students of understanding that there are alternative strategies and approaches to many mathematical problems, different ways of defining concepts, and even different constructions due to different starting points. In consequence, they may miss significant aspects of mathematical experience, including formulating their own questions, conjecturing relationships, and testing them. They may approach the tasks in class with a very narrow frame of mind that keeps them from developing personal methods and build confidence in dealing with mathematical ideas.

Associated with these conceptions are students' expectations of what is a mathematics classroom. If the teacher tries some innovative activities an overt or covert reaction of the students may quickly develop further inhibiting the learning process.

How resilient are such conceptions and expectations, once formed in students' minds? Are they a simple consequence of the climate of the mathematics classroom or do they acquire some sort of independent existence?

Despite the interest that this topic has recently attracted, not much is known about the possibilities of influencing these general views of the students, and especially, what can be the effects of new curriculum approaches purposely designed to improve their views and attitudes regarding mathematics.

Context of the Study

Led by the Portuguese Ministry of Education, a comprehensive global Reform of the state controlled educational system is under way since 1986. The Ministry lays out the plans concerning the different aspects of the Reform and publishes them as mandatory laws. Some of these are previously submitted for public discussion, but the final decisions are always made by the Ministry (in some cases contrary to the majority of the expressed opinions). This process can well be viewed as a variant of the classical "top down" approach for educational innovation, since in its development there is no significant input from the major addressees (Howson, Keitel, & Kilpatrick, 1981).

As part of this process of educational reform, an experience of new mathematics curricula for 7th and 10th grades and for a new 10th grade discipline called quantitative methods was conducted, in selected schools, during the school year of 1990-91.

The new curricula are organized in three strands of objectives: knowledge, abilities and attitudes/values. According to those we interviewed at the Ministry, one of the major aims was definitively the improvement of the attitudes of the students towards mathematics. The new curricula suggests a more intuitive approach to the mathematical concepts, with emphasis in graphical
representations and real world situations. Other new features include the introduction of probability and statistics from an earlier grade level and a greater attention to geometry. In terms of teaching methodologies, the use of calculators is recommended from grade 5 on and some attention is given to active methodologies and group work.

The new discipline of quantitative methods was meant for students of humanistic areas who did not have formerly mathematics in their plan of studies. The content is (a) logic and complex and real numbers, (b) statistics, combinatorics, and probability, and (c) functions. Its main purpose was, according to the official documents, to give students tools and ideas seen as “required for an integration in social and economical activity”, and also as “necessary for the development of a dynamic thinking structure”.

Since the subject matter of the experimental curricula underwent significant changes regarding the present content, the students involved in this experience had no textbooks. Instead, they used as their main study source support materials provided by the Ministry of Education, eventually complemented by other materials made by the teachers themselves.

The experimenting teachers had 3 hours of reduction in their weekly working load (which is 22 hours for beginning teachers). They were supported by a small group of accompanying teachers, especially created by the Ministry to assist this experience. The parents and the students were informed in the beginning of the school year that the school would be using a new curriculum. It was possible to transfer a student to a different school, not in the experience, but only a very small number opted for doing so.

The research team was composed by the authors of the present paper. None of us had so far a close relation either with this experience or with this school. However, we were generally critical of what we considered to be the absence of clear orientations in the new curriculum proposals.

Methodology

The study had three main phases. The first phase, preparation, included the formulation of research questions, the planning of field work (with the elaboration of interview and observation guides and of criteria for selection of informants), the outline of the final report, and a first contact with the field. The second phase included the conduction of field work and the third was devoted to writing the research report. The methodological approach and the field activities were strongly influenced by an interpretive conception of educational research, as described in Goetz and LeCompte (1984), Merriman (1988), and Patton (1987).

A detailed plan of activities was designed from the earlier beginning. It specified the actions to be carried out, the responsibilities of each of the members of the research team, and the approximate completion dates. In that respect, many of the suggestions regarding the design of a case study provided by Yin (1989) were taken into consideration.

Data was collected for this study through interviews (which were audio-taped and later transcribed), observations and documentary analysis. A number of people was interviewed, including teachers, administrators, Ministry officials and nineteen students, who were interviewed in groups. Each group had at least two boys and two girls (of whom two were high and two were low achieving students). The selection, based on these criteria, was made jointly by the teachers and the researchers. Observations were also made of classes (three at 7th and two at 10th grade) and of other school activities. Documental analysis was made of the text of the new curriculum, the materials produced by the Ministry and by the teachers, the reports of the accompanying teachers, and other school documents.

The field work was conducted in groups of two researchers (with one group focusing on 7th and another on 10th grade) and amounted to 130 hours. The research team had the cooperation of three assistants who transcribed about 50 hours of audio-taped material.

Data was analysed cross-checking all the information available regarding the study questions and subquestions and collectively discussing the emergent main issues. The final report (in which this paper is based) underwent a substantial process of successive drafts and revisions.

Overview of the Curriculum Experience

This experience had many components, including the selection of the participating schools, the elaboration of the new curriculum documents and their transmission to the schools, the preparation by teachers of the classroom implementation, regular classroom and interdisciplinary activities, the provision of ongoing support for the participation of the schools in the experience, and the feedback to the curriculum authors to make the appropriate revisions. In this paper, we are especially concerned with the students reactions; attention is focused on the classroom and interdisciplinary activities. Despite our initial skepticism, the closer contact with the actual school practice made clear to us that some innovative activities were taking place in the schools.

Classroom work. In the absence of textbooks, students made wide use of their own notebooks. The 7th grade classes were mostly structured around worksheet-based activities (containing exercises, conceptual questions, and problems). They were carried out in pairs, but sometimes also in groups of
four students, followed by discussions on the blackboard involving the general participation of the class. Students used the calculator naturally, when it was relevant for the task in hand.

The 10th grade class tended to be structured around the discussion conducted by the teacher. The main conclusions were written on the blackboard and then ready copied down by the students to their notebooks. It was quite noticeable that one of the teachers highly valued extra classroom activities, which very often were called to the discussion.

In the quantitative methods class there was little discussion. It was essentially based in worksheet activities, most of which were computational exercises requiring the use of the calculator, with the students working in groups of four in a very relaxed atmosphere. The teacher circulated in the class attending to requests from groups or individual students.

Overall, we witnessed a great variety of classroom activities, depending on the grade level and also on the teachers' styles. Even so, some common differences can be noted regarding traditional mathematics teaching: much more use of technology than usual, more attention to relations of mathematics and the real world, and in some cases more group work and more exploratory activities.

Interdisciplinary activities. Besides the change in curriculum contents for all disciplines, this experience also required the schools to organize interdisciplinary activities, to be supported by regular classroom work, up to a certain number of hours. The teachers at first did not realize all the implications of such requirement and hoped that it would be dropped. When it became clear that the Ministry insisted on the realization of these activities, they strongly complained and searched ways of avoiding them.

As educators, we feel that interdisciplinary activities are an excellent pedagogical idea. Activities of this nature are common in many schools, sometimes supported by some release time provided to the teachers, in other cases just based on teachers' volunteer time. But we must stress the striking difference between the reluctance with which teachers regard this sort of activities when they are mandatory and the willingness to organize them when they stand on their initiative.

Students' Views about Mathematics and Mathematics Classes

Of special interest in this paper is the issue of how were the students involved in this experience perceiving mathematics teaching and learning, as compared with previous years.

7th grade students. In general terms, they were satisfied with their mathematics classes and with the new curriculum. In the beginning, they were concerned because there was no textbook, but now they felt all right without it. Echoing a common complain of their own teachers, they also blamed the supporting materials (made by the Ministry), saying that these were not available when they should.

The students felt that classes were different. In their view, there was much group work, reports, investigations; there was more discussion, less work on the blackboard, more work on the notebook. They felt that the new curriculum implied more work and more thinking.

For some of them, mathematics classes were sharply split in two groups: theoretical classes (mostly done through writing on the blackboard) and practical classes (exercises on the notebook), the second being far more common. The mathematics class was seen as practical and active:

"In mathematics we are always doing something."

"Mathematics is exercises. It is a more practical subject."

Since there was no textbook, they said that more attention was required in class. They mostly felt that the use of calculators was all right (with some reservations from two girls). Regarding the computer, which they did not use in class, their opinions were sharply divided: some thought that it would help learning and welcomed it into the classroom, others did not.

These students felt that some changes had occurred in their assessment. Besides the test other things now also were taken into account: absences, attention, behavior, and notebook. Some of them felt that the tests had themselves changed:

"A new test with a few questions corresponds to an old one with many questions."

10th grade students. They felt particularly insecure in the beginning of the school year; how would it be with no textbook? Some of them even considered the possibility of changing to another school. Now they were still insecure about the implications of this experience in the process of application to a University (that will take place after they completed the 12th grade).

But these students felt that all the disciplines were going all right. Regarding their previous experiences, mathematics was the subject that had less changes:

"Mathematics is a practical subject... [you go through] new contents and then solve exercises... Mathematics is really to make you think."

They did not like very much the supporting materials made by the Ministry since they felt that the exercises were too easy; they preferred the teaching materials made by their own teacher. Calculators were used in the topic of statistics but now were left at home because they were no longer necessary (the required computations being quite simple). Some of them were in favor of group work, but major group projects only took place twice during the year, and concerned work done outside the classroom. Others wondered if doing investigation-like activities was appropriate for mathematics or better suited for other subjects, such as Portuguese.
These students were much concerned with their grades. They felt that the tests were the dominant factor, but indicated that the weight of class participation and other works had also increased.

They particularly disliked the interdisciplinary activities. They felt that they were not well conceived and implemented, and regarded them as a distraction to the more important learning activities. They were so serious about this that even made a document to give the interviewers stating their position on this matter.

Quantitative methods students. These are students of the humanistic strand, who in the past usually finish their study of mathematics at 9th grade.

They felt that this new discipline was nothing but mathematics with a different name, which they did not like since they did not like mathematics. These students considered that the subject matter was quite boring (in their words: "it is always the same thing") and missed the security of the regular textbook. They did not like what they called the "horrible" supporting materials and did not feel any particular enthusiasm about the use of calculators.

These students also did not like group work. However, they felt that the evaluation had changed somehow: the analysis of the notebook and the results of group work were now also taken into account.

Conclusion

This experience implied quite significant changes in the life of the students. For the first time in their school experience they did not have textbooks. They were presented with a different sort of mathematical activities which were perceived as requiring more thinking. Also, although that was not necessarily new for all of them, they were required to do much group work, made a significant use of the calculator, and engaged in interdisciplinary activities.

The students reacted in a very positive way towards the absence of the textbook. They took care in organizing their notebooks and found them a useful study base. The challenge of different and more demanding mathematical activities was well taken by them. At 7th grade they were positive about having problems requiring more effort and thinking. And at 10th grade the students took themselves the initiative of asking the teacher more difficult problems. They were quite positive about the active nature of mathematics classes and their reactions to group work were generally favorable.

The most notable exception to this general pattern were the students of quantitative methods, who must be regarded as a very special case. They were very unhappy about having to study mathematics at this point of their school life and were negative towards everything that had to do with this experience. There is a remarkable parallel between the lack of enthusiasm of the students and that of their teacher. It is difficult to know which one come first, but at this point they just seemed to be reinforcing each other.

The most striking difference in the attitudes of the 7th and 10th grade students concerns the interdisciplinary and project-like activities. The students in the 7th grade were favorable and those in the 10th grade were very negative. Younger students still have interest in what the school may offer them, while the older ones appear to be led mostly by personal extra school interests or long term concerns with University admission. They saw the process of Reform as mostly bringing them serious handicaps.

All the students were clearly aware that they were participating in a curriculum experience. For 7th graders, it seemed to have an impact in their vies and attitudes towards mathematics. For 10th grade students, the experience seemed not to affect their view of mathematics or mathematics learning.

This experience suggests in a remarkable way that there is a relationship between the views and attitudes of the teachers and those of the students. When teachers are negative towards something, so are the students. When they are positive, they seem to influence the views and attitudes of the younger students. At the 7th grade these can afford to be optimistic and willing to accept some of the values and challenges coming from the teachers. On the contrary, the 10th grade students transmitted clearly an image of independence. Therefore, the changes that bear with their expectations and affect their normal routines need to be introduced with especial care and subtlety.

References


