



SOCIOCULTURAL AND HISTORICAL ELEMENTS IN SECONDARY MATHEMATICS

Ioanna Georgiou describes her research on *Cultural Mathematics* and the challenges that arose.

I will first introduce the context of the research, I will briefly describe the preparation for the course, with minimal comment on the methodology. Finally, I will present some of the challenges that arose during the course, using the categories that emerged from the analysis. Please note that all the names, including the name of the school are pseudonyms.

The context of the research

The research took place at an independent English-speaking secondary school in Cyprus, where roughly 30% of the secondary students attend independent schools. *Æsop* school offered six-year education, equally divided amongst KS3, 4 & 5. The *Æsop*'s pedagogical committee was concerned with a group of year ten underachieving students, who would be greatly challenged if they pursued the standard AS/A2 curriculum in almost any subject. After a number of meetings the proposal for a new Broad Schooling Scheme (BSS) was approved, and the design of the BSS began.

Teachers were asked to share ideas on subjects that might be included in the programme. My suggestion was *mathematics through history and culture*; it entered the timetable – six 40-minute periods per week – as *Cultural Mathematics*. The BSS was implemented during school year 2007-08 on a pilot basis.

The BSS class of thirteen students was widely multicultural: Greek-Cypriots, Armenian-Cypriots, British, South-African, Filipino and more mixed backgrounds. *Æsop* school had an even more widely multicultural character.

Preparation for the course and the research

As I was only entering my second year of teaching when the research project started, I chose to use a 'pre-approved' curriculum upon which I would develop *Cultural Mathematics*. I therefore took the core maths textbook of the ministry of education, and Cyprus pedagogical institute, to be used as the basis for the contents of the course. I re-wrote the book, using a variety of sources relating each topic to history, culture or social justice issues.

The methodology I found most appropriate was action research. This methodology is generally recommended for practitioner-researchers, either seeking to improve their own practice, or their work environment. The features of action research include constant interaction with the participant, and seeking for feedback on how the new ideas implemented are affecting their own performance or practice. One way to implement action research is with using the *planning-acting-observing-reflecting* cyclic spiral.

The data collection methods used included assessment evidence – tests, quizzes, projects, project presentations, daily assessment on participation/behaviour and homework, my personal journal, questionnaires, very few interviews – due to space and time constraints, and classroom and informal discussions.

The nine categories

All the material collected was scanned thoroughly twice, and two different sets of categories of events emerged. As the two sets differed substantially from one another, a 2-D grid was used to identify overlaps between the categories. The first list was used on the 'y-axis' and the second on the 'x-axis'. This resulted in a new list of nine categories of events. The list of categories with brief comments on each one follows. It has to be noted that in each category the events appear in chronological order, thus identifying any progress as the course evolved.

Complaints heard

This category includes student, management, and teacher's complaints. For example, the students complained about the size of the folder their notes came in, the management complained about student's minimal efforts and my complaints were mostly related to student's standard obligations, such as to bring their notes with them, or do their homework.

Traditional exercises

This category was created in order to investigate how students reacted towards more 'standard' material, in contrast to the new material I presented them with.

Students helping each other

The events when students helped each other, such as group-work or offering answers during class discussions were of interest because of the nature of action research, aiming to improve the functioning of a certain environment; – students becoming more collaborative with each other would signify some success. Moreover, as Lawrence (2006) had identified, class cohesion seemed a significant factor for the success of the new materials, or approach.

Quizzes/tests/assessment

This category on assessment results, was used to identify any fluctuations in student performance, although none of the assessment items used was standardised. They were devised, by myself, according to the contents taught.

Project writing and presentation occupies a special category and a separate section on its own.

The specific cohort of students had never completed a project for mathematics before, and the presentations were used to assess student understanding. For example, during the presentation of a project, a student mixed up Pythagora's birth and death dates; this revealed a misconception on BC dates. Others helped to explain the mistake. This misconception was only revealed because of the presentation.

Complexity adjustment to student level

This category involved major changes or eschewing of parts students found so challenging that were insurmountable.

Difficulties with mathematics

This category refers to 'milder' issues than the previous one, in the sense that the difficulties in this category were addressed, and students made some progress with respect to these aspects.

Student interests and contributions/teacher challenged

The combination of events that make up this category only emerged after the construction of the 2-D grid; it was revealed that all the occasions where I found myself in a challenging position, were connected with the students raising their own issues in class.

Break tasks/readings and fun

In this category I collect all the cases where the tasks chosen were intended as short breaks from the main lessons, such as maths-related readings, strategy games, riddles and so on.

H/C/Sj

This last category is broad; it encompasses historical, cultural and social justice related events and it provides evidence on how such topics were found more frequently as the course evolved, with students being more eager to get involved with them.

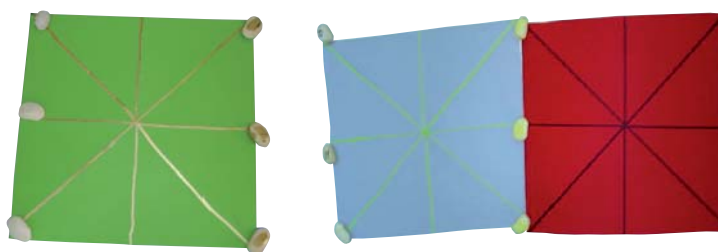


Figure 1: Students' own game boards (category eight). More can be viewed at: www2.warwick.ac.uk/fac/soc/wie/courses/degrees/docs/who/students/edrfbh/teaching/ © Ioanna Georgiou

The group expressed various complaints quite frequently; some phrases that matched my everyday experience with the BSS students were: "Miss, I

didn't do the last one", *"We use them to work out..."*, *"I didn't know them before"*, *"Miss, I am not good at these"*. The students complained of not understanding, not being good, not being able to complete their tasks and so on; this was not necessarily the case, but rather their low self-esteem.

At the end of October, while proceeding with the course, making minor and rather anticipated adjustments, some students expressed their dislike of the lesson. The timing of the complaints was inconsistent with the content of the complaints. Students mentioned that they do not want to be *'doing history'* and *'doing English'*, at the same time as dealing with traditional exercises. The exercises involved substituting in formulas and finding terms of sequences. Although when history, or readings arose, some students showed their dislike, with behaviour such as minimal or no participation, they complained at an unexpected point in the course.

Their first complaint regarding *'doing English'* was heard in mid-September, when reading a newspaper article telling a story about how mathematics is used for several amenities we use in our everyday lives. Although the article was clearly about mathematics, some students refrained from participating. Although the situation continued to challenge me, and the items I chose to include in each lesson, when reading a transcribed university lecture on unsolved problems, two and a half months later, their attitudes appeared to have changed. The importance of the text was about students realising that even professional mathematicians encounter difficulties when dealing with mathematical problems. Moreover, students would learn that not all problems have solutions, and that the *'production'* of new mathematics is an endless procedure. The students willingly offered ideas on ways in which a mathematician might become a millionaire – and expressed surprise when they found out that solving a mathematical problem could help someone earn so much money.

When dealing with the sine rule, extending the calculation of the sine of an angle and to the angle itself appeared to be incomprehensible for the students. Therefore the exercises given were

restricted to substitution. In spite of this amendment, the demands of the chapter were still found overwhelming. Further adjustments were made, such as providing a table of values for sin, cos, tan of 0, 30, 45, ... instead of using random values; this revealed that students had never dealt with complex fractions, and they thought they had to cross-multiply. The variety of difficulties encountered lead to students becoming disenchanted and resulted in eschewing trigonometry.

An issue of tradition or habit and religion emerged while discussing the time line. A student plausibly asked *"Why do we measure time using Christ's birth and not that of Mohammed or Buddha?"* This was a case where mathematical knowledge interfered with history and culture. The limits are sometimes unclear when using history and culture to teach mathematics. The discussion had prompted a student to ask a question relevant to the topic, albeit not to mathematics. Engaging students and allowing connections, can lead to increased interest in mathematics. An additional challenge was the fact that the answer to the question was outside my knowledge, as can often happen.

In conclusion, to approach mathematics lessons using sociocultural, and historical elements is neither straightforward, nor a remedy for re-engaging students. Careful study and design is required if the material is to be found interesting and intellectually fascinating by students. Nevertheless, it is worthwhile as such a change has the potential to result in higher levels of engagement – evidenced by increased levels of participation; increase interest – evidenced by students bringing in their own material and questions; as well as higher attainment levels, since the students will be studying for something that makes sense and it is part of their lives.

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