

The Importance of Mathematics Textbook Analysis in relation to Students' Learning and Understanding of Mathematics

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Background

The author, having conducted exploratory research as a final year project, identified an overwhelming expectation for the mathematical textbook to embrace all aspects of mathematics teaching and learning. Much international research has been carried out on the influence of mathematical textbooks, with Irish textbooks only playing only a minor role in the TIMSS analysis (Valverde et al, 2002). Irish students have performed poorly in the PISA reports from 2001, 2003 and again in 2006, and are currently only ranked in the middle of the OECD countries for mathematical literacy (Cosgrove et al., 2005). In 2005 the National Council for Curriculum and Assessment identified that mathematics in Irish post primary schools is currently being taught through a didactic style of

teaching with the textbook playing a central role. Also, the textbooks focus entirely on what the NCCA report calls 'vertical learning'. Vertical learning can be described as the manipulation of symbols and the process of transferring this mathematical knowledge into real world (NCCA, 2005) and with a multitude of information sources available to students, it is more important than ever that there is an improvement in the mathematics textbooks. Students' experiences of mathematical textbooks will undoubtedly impact their ability to learn individually from textbooks (Robinson, 1981), a skill highly valued at third level.

As part of her doctoral studies the author is investigating the impact of the current Irish Junior Cycle (equivalent to GCSE) Mathematical Textbooks on student learning and in particular, their understanding. With the textbook placed in such a pivotal role within the classroom the impact of the textbook on student learning is unquestionable. However, the textbooks preparedness for this significant role is in question. This research, by means of textbook analysis, identifies the effectiveness of the current Irish Junior Cycle Mathematics textbooks for student comprehension and motivation. The focus of this paper is on the impact these findings will have on the students learning and in particular on their comprehension and motivation to engage in mathematical learning and understanding.

Research Questions

The focus of this research aims to answer the following research questions:

- What is the role of the mathematics textbook in Irish Junior Cycle Classrooms?
- Do particular features of the textbooks cause difficulty for teaching or learning?
- What aspects of textbooks can be improved or included to enhance learning and teaching?
- Which of the four textbook series analysed in this study are most effective for student learning of mathematics in terms of following:
 - o - Layout and structure of the content?
 - o - Overall textbook structure?
 - o - Readability levels and language used?
 - o - Expectations being placed on students?

Methods

Qualitative and quantitative approaches to research have dominated research culture and it is only in relatively recent times that researchers are opening to the idea of mixed methodologies. Individually

both these methods have their own merit; however the combination of these methods provides greater insight into the research. The mixed method combines quantitative and qualitative at the methodology stage of research in contrast to a mixed model of research which combines quantitative and qualitative throughout the research process. The application of a mixed model approach allows the author to exploit the strengths of both methods while minimising the limitations. Bryman (1996: 105-107) provides a framework for the mixing of qualitative and quantitative research methods which is employed systematically throughout the research. The mixed model is applied at each stage of the analytical framework with a combination of qualitative and quantitative methods applied to data collection, analysis and interpretation.

Frame

Due to the nature of this study a number of theoretical frameworks are employed for the textbook analysis (Rivers (1990), (Robinson (1981), TIMSS (2002)), of which the analytical framework for this research encompasses all. The analytical framework is primarily based on the work of Valverde et al (2002) and Morgan (2004) and provides the basis for the data collection process:

- Content Analysis
- Structure Analysis
- Expectation Analysis
- Language Analysis

The textbook analysis is carried out using a combination of researched frameworks for textual analysis based primarily on the TIMSS analysis. A number of relevant frameworks for analysis are applied in conjunction with the TIMSS framework for analysis such as Rivers Matrix (Rivers, 1990). Together these frameworks serve to identify the presence of textbook features which directly impact on students learning.

Research findings

Currently in Ireland, Project Maths (a new curriculum initiative due to be implemented in September 2010) is being piloted in 24 second level schools. This curriculum initiative aims to enhance the uptake of Leaving Certificate Higher Level mathematics. Project Maths is approaching this aim from a number of directions, one of which is improving the standard of Junior Cycle mathematics. In order to achieve this aim they will need to introduce and encourage the use of effective resources and textbooks.

A number of interesting facts have emerged from the textbook analysis to date:

- Minimal correlation with Rivers Matrix, this impacts directly on student motivation and comprehension.
- Less than one quarter of all exercises in the textbook can be classified as problems, primarily routine problems.
- All textbooks (involved in this study) have limited and inconsistent use of colour and a deficiency of real life graphics and reference to ICT.
- Expectation and textbook focus is predominantly on the completion of exercises.
- There is an obvious lack of weight on understanding.

These findings will significantly contribute to expected changes within the Junior Cycle curriculum and classroom practices, by identifying the current situation and providing recommendations for change. This research is the first of its kind and not only provides methods for textbook analysis but also gives detailed insights into textbook features which directly impact on student comprehension and motivation.