

Primary Teachers' Beliefs About the Use of Mathematics Textbooks

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This paper describes a small-scale investigation of the beliefs teachers hold about student textbooks and the factors that influence their decision to use them in mathematics lessons. Findings suggest that teachers' decisions to use textbooks in mathematics are influenced by external factors, the teachers' perceived educational value of textbooks and, the teachers' personal confidence and competence to teach mathematics. However, there is some evidence to suggest that contrary to previous studies, the 34 Queensland teachers surveyed appear to make less frequent use of textbooks and are more discerning about the manner in which they use textbooks in their classrooms.

In contemporary primary mathematics classrooms the existence of commercially produced resources such as concrete materials, tuition software and student textbooks is widespread. Such resources have been designed to complement and augment mathematics teaching and learning. Research in recent times has shown Australian teachers are dependant on a wide variety of these commercially produced curriculum resources, particularly the student textbook, for delivering the curriculum (Shield, 1991; Watt, 2002). However, teachers' heavy dependence on the mathematics textbook as a means of improving the educational outcomes of students is problematic, as the value of textbooks to student learning is presently ill-defined (Zevenbergen, Dole, & Wright, 2004). Taking into account the lack of conclusive evidence supporting the efficacy of textbooks, the reasons for Australian teachers' commitment to implementing student textbooks in mathematics classrooms is unclear. This ambiguity is further pronounced when one considers the widely held belief amongst educators that teaching is enhanced when underpinned and informed by research and theory (Knobel & Lankshear, 1999). If not research, then on what are teachers basing their decision to use textbooks in primary mathematics classrooms?

Throughout history, mathematics textbooks have been synonymous with mathematics education (Fauvel, 1991; Gray, 1990; Love & Pimm, 1996). In many instances, historical mathematics textbooks are often all that remains as a record of mathematics programs of the past (Love et al., 1996). One of the earliest documented mathematics textbooks written with a scholarly approach to mathematics is Robert Record's "The Ground of Arts", published in 1543 (Fauvel, 1991). Written entirely in dialogue between Master and Scholar, the purpose of "The Ground of Arts" was to instruct readers (scholars) in the basics of elementary arithmetic: numeration, addition, subtraction, multiplication and division. Record's mathematics textbook was widely successful and was reissued a number of times both during his lifetime and after his death. This book's immense success became a catalyst for the authoring and publishing of numerous versions of mathematics textbooks, a trend which continues to the present day.

The technology of printing allowed the ideas of educators and academics to be shared and made readily available to the general population. Educators welcomed this reformation and adapted their procedures to make best use of the means by which education was now being disseminated (McClintok, 1999). Such success has led to mathematics textbooks dominating both the perceptions and practices of school mathematics.

Textbooks have remained significantly unchanged, and as with schooling of the past, contemporary schooling is characterised by a heavy dependence on textbooks (Chambliss & Calfee, 1998; Woodward, Elliott, & Nagel, 1988). The teaching of mathematics relies on textbooks more than any other subject area (Johansson, 2006). Used in up to 90% of

mathematics lessons, the mathematics textbook is often the teacher's source of content, sequencing and instructional activities and ideas for lessons (Johansson, 2006; Reys, Reys, & Chaves-Lopez, 2004; Woodward et al., 1988).

Results regarding the quantity of use of student textbooks in Australian schools are consistent with the findings of published research from international studies, which find textbooks are basically used as the defacto curriculum (McNaught, 2005; Watt, 2002). Findings from a recent nationwide study conducted on the role of curriculum materials in Australian Schools indicated that textbooks, used 86.6% of the time during scheduled lessons, play an important role in the development of the curriculum (Watt, 2002). It is a reality of modern times that despite the lack of Australian evidence endorsing their positive value, student textbooks are a mainstay in primary mathematics classrooms, and in many instances are used daily by the classroom teacher. Despite this reality, very little research carried out in the Australian context, particularly in recent times has been dedicated to examining the efficacy of textbook use in primary mathematics classrooms, nor the reasons teachers rely on them so extensively.

Teachers' Beliefs About Mathematics Education and Textbook Use

The literature suggests that a teacher's beliefs about mathematics education are a primary factor influencing their decisions to use student textbooks. Specifically, the beliefs a teacher holds about mathematics education potentially influences both how frequently textbooks are used, in addition to the manner in which they are used (Manouchehri et al., 2000; Stipek et al., 2001). Teachers who hold beliefs about mathematics education consistent with a traditional approach to teaching and learning are more likely to use student textbooks, and they tend to follow the pedagogy and sequences embedded within the student textbook and the accompanying teacher's guide (Stipek et al., 2001). On the other hand, teachers whose beliefs correlate with a constructivist approach to mathematics are more likely to either teach without, or modify the activities within student textbooks (Kagan, 1992; Stipek et al., 2001).

However, this relationship between the beliefs about mathematics education a teacher holds and their use of student textbooks in mathematics is not consistent, and there are inconsistencies between teachers' professed beliefs and their classroom practices (Handal, 2003; Speer, 2005). The foundations for such inconsistencies is likely due to the complexity of the belief construct itself and the fact that a teacher's overarching beliefs about mathematics education and their subsequent classroom practices are mediated by a number of internal and external factors. The decisions teachers make about the implementation of student textbooks in mathematics are influenced by their beliefs regarding their own level of confidence and competence to teach mathematics, perceived pressure from external forces such as administrators, parents, and fellow teachers, as well as their judgements about the educational quality and value of student textbooks (Handal, 2003; Kagan, 1992; McNaught, 2005; Pehkonen, 2004; Stipek et al., 2001).

The research study reported in this paper investigated teachers' commitment to using student textbooks in primary mathematics classrooms in two Queensland primary schools. The aim of the study was to determine what the contributing factors are that influence the teachers' decisions to use student textbooks in primary mathematics classrooms. The study also investigated the frequency and pattern of use of student textbooks by these teachers.

Method

From a comprehensive review of the literature pertaining to teacher beliefs about the use of textbooks in mathematics education a teacher survey was designed. The survey contained three main parts: Part (a) comprised 10 items asking about the teachers' demographics, Part (b) comprised 14 items that used a 5-point Likert scale (Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree) to investigate

teachers' beliefs about mathematics education and student textbooks, and Part (c) comprised 6 items investigating the frequency and patterns of student textbook use in mathematics. Part B of the survey instrument was specifically designed to measure the following three teacher belief dimensions gleaned from the literature:

- Beliefs about the external influences that impact on teachers' use of student textbooks in primary mathematics classrooms.
- Beliefs about the teachers' perceived educational value of student textbooks in primary mathematics.
- Beliefs about the teachers' personal confidence and competence to teach primary mathematics.

The subjects involved in this study were 34 teachers from 2 urban primary schools at the Gold Coast, Australia. The teachers' demographic data are displayed in Table 1.

Table 1

Demographic information detailing teacher numbers by school, gender, years of teaching experience, and year level taught

Demographic Descriptor	Number of teachers	%
School 1	12	35
School 2	22	65
Female	32	94
Male	2	6
0-5years experience	10	29
6-10 years experience	3	9
11-20 years experience	8	24
20+ years experience	13	38
Preschool	2	6
Year 1	6	18
Year 2	10	29
Year 3	5	14.5
Year 4	2	6
Year 5	3	9
Year 6	5	14.5
Year 7	1	3
Total	34	100

As indicated in Table 1, teachers across all primary year levels, from preschool to Year 7 were represented. The early childhood sector was particularly well represented, with 67.5% of the teachers indicating their current year level being Preschool to Year 3. In terms of experience, 62% of teachers in the study had 11 or more years of experience, thus the majority of teachers could be described as very experienced. The majority of teachers were female (94%) and this reflects the overall demographic distribution in the two schools.

The survey was administered to the teachers at each school as a group during a scheduled staff meeting in order to minimise disruption and inconvenience for teachers. Research indicates that face-to-face administration of surveys is quicker, more accurate and obtains more returns than a mailed self-completion survey (Burns, 2000). Also, questions to clarify the items can be addressed immediately to ensure that all respondents

understand the items. The data collected from the surveys were then analysed using the Statistical Package for the Social Sciences (SPSS15).

Results and Discussion

This small pilot study aimed to explore the relationship between teachers' beliefs about mathematics education and their use of student textbooks, and was guided by the following research question:

What is the relationship between the frequency and patterns of use of student textbooks in primary mathematics classrooms and teachers' beliefs about their use?

Frequency and/or Patterns of Textbook Use As Reported By Teachers

The data collected from the thirty-four teachers involved in this study provides an interesting insight into both the frequency and the patterns of student textbook use in two Queensland primary schools. Although it was expected that textbooks would be used frequently based on the findings of international research which suggests textbooks are used in up to 90% of lessons, and Australian research which indicates textbooks are used 86.6% of the time (Reys et al., 2004; Watt, 2002), there is an indication from the data that teachers in this study are less dependant on textbooks than the literature suggests. In response to item 15 (My students use a mathematics textbook as part of the planned mathematics lessons most days), over 70% of teachers surveyed in this study indicated that they 'Sometimes', 'Occasionally' or 'Never' use the textbook this frequently. The remaining 30% of teachers who responded with 'Usually' or 'Always' to this item appeared to use textbooks as frequently as the previous studies have indicated – basically in nearly every mathematics lesson. Of the five teachers who did respond in this manner, only 1 teacher reported that he/she 'Always' used student textbooks in mathematics lessons. Thus, it might be inferred that Queensland primary teachers, as represented by the teachers surveyed, are not as reliant on textbooks as is reported in the literature.

Evidence of this lesser dependence on student textbooks in mathematics was also found in the teachers' responses to item 19 (I prefer to teach mathematics lessons with a mathematics textbook). For this item, over 80% of the teachers indicated that they do not 'Usually' or 'Always' prefer to teach mathematics with a textbook.

Further, as with the findings related to the frequency of textbook use, there is an indication that how textbooks were used in the two schools was inconsistent with the findings of previous research. Based on the results of this study it appears that the teachers showed flexibility and changeability in their use of textbooks. While the literature suggests that a teachers' sequence of instruction often matches the sequence laid out in textbooks (Johansson, 2005), over 55% of the teachers surveyed reported 'Never' following the textbook's sequence of lessons, with no teachers indicating they 'Always' follow the textbook sequence. Furthermore, while the literature also implies that the topics presented in textbooks are the topics most likely presented by teachers (Johansson, 2005), the teachers surveyed not only reorganise the sequence of the textbook, but 70% proactively select what they feel is appropriate from the textbook to present in their mathematics lessons.

Lastly, items 17 (All of my students use a mathematics textbook regardless of their ability), and 18 (My students all work on the same activity at the same time from their textbook) pertain to the patterns of textbook use in relation to the different abilities of students. Of the thirty-four teachers, nineteen teachers reported that the students in their class work on the same activity from the textbooks at most 'Sometimes', with only 3 teachers reporting their students 'Always' work on the same activity. Combined with the data from item 17 to which over one third of the teachers reported that they 'Never' have students working from textbooks regardless of ability, it seems that the teachers in these

two schools cater to individual abilities and student needs when using textbooks in mathematics lessons.

Relationship Between Frequency and/or Patterns of Textbook Use and Teacher Demographics

The literature suggested that teacher demographics such as gender, year level taught, and years of experience have been found to influence the classroom practice of individual teachers (Nisbet et al., 2000). To investigate the relationship between teacher demographics and textbook use, a series of Chi-square (χ^2) tests were conducted. The results of the Chi-square (χ^2) tests for teacher gender and years of experience obtained non-significant results, and as such in this study it is implied that teacher gender and years of experience do not significantly influence teachers' decisions to use student textbooks in mathematics.

However, for item 18 (My students all work on the same activity at the same time from their textbook), the results indicated that the school at which teachers were employed significantly related to how the textbooks were used. Of the teachers from school 1, 11 out of 12 reported that their students 'Never' or only 'Occasionally' work on the same activity at the same time. Conversely, of the teachers at school 2, 15 out of 21 reported that students are 'Usually' or 'Always' working on the same activity at the same time. Thus, even though it appears that the teachers in this study cater for individual student abilities and needs more than has been reported in previous studies, this result was statistically related to the variable 'school'. These two schools indicated different patterns of use with respect to whether students all work on the same activity at the same time or not. However, as there were only two schools in this study, significantly more data would be required before making generalisations about the impact of the 'school' on teacher use of mathematics textbooks.

Significant results from the Pearson Chi-square tests were also obtained for year level taught in relation to item 15 (My students use a mathematics textbook as part of the planned mathematics lessons most days), item 16 (My students use the mathematics textbook for supplementary educational activities eg. homework, time-filler, enrichment activities), and item 19 (I prefer to teach mathematics lessons with a mathematics textbook). For each of these items there appears to be a relationship between year level taught and the patterns of textbook use, with teachers in higher year levels using textbooks during scheduled mathematics lessons and for supplementary educational experiences more frequently than teachers in lower year levels. Additionally, the teachers in higher year levels preferred to use textbooks in the teaching of mathematics more so than the teachers in lower year levels. Once again however, the small data set does not allow definitive conclusions to be made.

However, the inconsistencies between previous national and international studies which suggest that textbooks are used frequently and often without modifications, and the data from this study which suggests teachers use textbooks more moderately and display initiative in modifying both the sequence and the content of the textbooks, are possibly related to the lack of Australian research at the primary school level. The difference between this study's findings and those of previous studies would be worthy of further investigation.

Relationship Between the Teachers' Perceived Educational Value of Student Textbooks and the Frequency of Their Use in Mathematics

The results pertaining to the educational value of student textbooks in mathematics were indicative of previous research which suggests teachers have strong positive beliefs about the educational value of student textbooks. When surveyed, these teachers typically reported positive beliefs about the educational value of student textbooks in mathematics.

The results indicate that there is a particularly strong belief held by teachers in this study in regards to the value of the textbook as a source of opportunities for students to practice mathematical skills. The pedagogy of contemporary mathematics textbooks is described in the literature as being focused on skill acquisition through a heavy emphasis on procedural practice (Ball et al., 1988; Chavez-Lopez, 2003). Results from this study seem to indicate that teachers place positive value on this aspect of textbook pedagogy, with half of the teachers surveyed reporting that they believe mathematics education should include the use of a textbook to allow students to practice mathematical skills. Interestingly, 38% of the teachers were undecided as to the value of student textbooks in providing students with opportunities to practice mathematical skills. In fact, despite the overriding positive beliefs in regards to the textbook's educational value, there was a significant portion of the teacher sample who reported they were undecided for each of the items relating to the educational value of student textbooks. An obvious is therefore: 'Why do significant numbers of teachers (30% in this study) 'Usually' or 'Always' use textbooks in mathematics lessons if they are undecided about the value of the textbook to student learning?' This question alone could provide the foundation for future research investigations. Overall however, the teachers surveyed believe the student textbook is a valuable teaching and learning aid in the mathematics classroom, particularly as a resource to provide students with opportunities to practice various mathematical skills.

Relationship Between External Influences Perceived by Teachers and Their Use of Student Textbooks in Mathematics

A Kruskal-Wallis Non-Parametric test provided evidence of a positive relationship between teachers' beliefs about external influences and the frequency they use student textbooks in mathematics lessons; a result which supports previous studies. Policies in place within schools and the perceived pressure from administrators and parents to use student textbooks are external factors recognised in previous research as potentially influencing teachers decisions to use textbooks (Handal, 2003; McNaught, 2005; Perso, 2005). Furthermore, there is the suggestion in the literature that the increasingly heavy workload demands placed on teachers encourage them to rely on the textbook's pre-planned lessons. Data from this small study supports this position, with only 23% of teachers disagreeing with survey item 8 (I use mathematics textbooks with my students because I believe it makes teaching mathematics easier). Also, a third of the teachers reported that they use a textbook in mathematics because it is expected by parents (item 12).

Relationship Between Teachers' Personal Confidence and Competence to Teach Mathematics and Their Use of Student Textbooks in Mathematics

Overall, the teachers surveyed hold very positive beliefs about their levels of confidence and competence to teach mathematics. Over 50% of the teachers indicated they either 'Agreed' or 'Strongly Agreed' with item 1 (I enjoy teaching mathematics), item 2 (I teach mathematics to my class confidently), item 3 (I would feel confident to teach mathematics to any primary year level) and item 4 (I believe I am a competent teacher of mathematics). In fact, for items 1, 2 and 4, 70% of teachers were in agreement with these statements.

Previous studies suggest that teachers with high self-efficacy regarding mathematics education are more likely to modify or teach without textbooks (Stipek et al., 2001). This result is supported by this study in which the majority of teachers have positive beliefs about their levels of confidence and competence to teach mathematics and at the same time make only a moderate use of student textbooks during mathematics lessons, with 20% indicating they 'Never' use student textbooks. Furthermore, as suggested earlier these teachers indicated that they modify the textbooks by reorganizing the sequence and

selecting only what they feel is appropriate from the book for use in their mathematics lessons.

A prevalent suggestion throughout the literature is that low self confidence and competence in teaching mathematics leads teachers to develop a heavy dependence on textbooks as a means of overcoming their perceived shortcomings (Ball et al., 1988; Chambliss et al., 1998). As such, the strong positive beliefs held by these teachers about their confidence and competence to teach mathematics may provide some insight into the inconsistencies between previous research suggesting frequent use of textbooks in mathematics, and the results of this study which finds the majority of teachers from these two schools use student textbooks at most only 'Sometimes'.

Furthermore, the literature indicates that teachers with low levels of confidence in their subject matter knowledge in mathematics often hold the belief that textbook authors possess more mathematical expertise (Ball et al., 1988; Chambliss et al., 1998). It is inferred that teachers who hold this belief become textbook dependant as they believe the authors of the textbook are better able to develop a mathematics program. However, 38.2% of teachers surveyed, disagreed that the authors of mathematics textbooks know more about teaching mathematics than they do, compared with 14.7% who agreed with the statement (item 7). The teachers in this study were relatively confident about their ability to teach mathematics to their particular year level and the results indicated that teachers do not rely on the authority of the textbook when deciding the sequence of mathematics lessons, or which topics are appropriate for students in their class.

In conclusion, the results of this study suggest that student textbooks are used less frequently and in different ways than has been previously reported. However, teachers' beliefs about student textbook use in mathematics align reasonably well with the literature. The teachers involved in this study appear to be making use of student textbooks in their mathematics lessons, as on the whole they possess beliefs that student textbooks are of sound educational value. Also, the strong positive beliefs held by these teachers in regards to their personal confidence and competence to teach mathematics suggests that these teachers are often proactive and thoughtful about their use of textbooks. The teachers report that they reorganise the sequence of the textbook in addition to selecting only what they feel is appropriate from the textbook for use with their class.

However, results of the study also demonstrated that for each of the survey items relating to the factors deemed influential on teachers' decisions to use student textbooks in mathematics: the perceived educational value of student textbooks, external influences, and teachers' perceived levels of confidence and competence to teach mathematics, a large number of teachers reported that they were undecided as to the reasons they use textbooks. This result is of interest, particularly in regards to the large numbers of teachers reporting they are undecided about the educational value of textbooks. Coupled with results which indicated the majority of teachers did not use textbooks because of school policies, or because parents expect textbooks to be used, the result is even more perplexing. It could be questioned from this result why the teachers at these two schools continue to use student textbooks, even to a moderate degree, if they are undecided about the educational value of the textbook and there is not a strong influence on them from external sources to use textbooks. This question could underpin future research investigations.

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