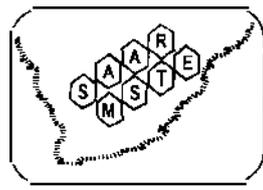


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The implemented curriculum: using science textbooks in Namibian classes

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Abstract

This paper surveys the ways Namibian science teachers use prescribed textbooks. Instances of textbook use are identified in 29 lessons through non-participant observations and verbatim records of class interactions. Using a classification scheme from linguistics, these instances are grouped according to their field (pedagogic purpose), mode (textbook genre) and the tenor (nature of the accompanying social interactions). Findings show that in a large percentage of (particular senior) classes the book is not used. If used, the focus is on diagrams and tables, and on the book's role as authority of knowledge. Whole-group usage of the book in class predominates, followed by individual use for homework. Explanations of the findings are sought in teachers' perceptions of the nature of science, their role as providers of learning, and their confidence as science content experts. Suggestions for teacher training programmes are provided.

Introduction

International surveys highlight the significant role of textbooks in science education (Walberg, 1991). While considerable sums are invested in textbook purchases, research on textbooks has focused largely on the linguistic challenge of the text rather than on how textbook usage is managed by the teacher to support learning. Research on the readability of textbooks has been quite common (e.g. Zabaluk and Samuels, 1988) and encompasses studies of learners for whom English is a second language (ESL). More recently, genre analysis has been used to study the issue of ESL learners' access to science textbooks (Kearsley and Turner, 1999). They found that learners have problems switching from everyday English (often used in topic introductions) to the more scientific genres used in subsequent sections. Such research is helpful for curriculum designers and facilitate the provision of more appropriate texts to support the intended science curriculum. However, the implemented curriculum may be very different. A recent report of newly qualified teachers' (NQTs) use of science textbooks (Peacock and Gates, 2000) shows that while a wide variety of teaching activities was presented in the text, the NQTs used less than half of these. This illustrates the gap between the intended curriculum (as reflected in the textbook) and that taught by the teacher.

Halliday and Hasan (1976) consider the school textbook as an example of a 'register' of communication, i.e. 'a set of meanings and configurations of semantic patterns, that are typically drawn upon in specific conditions, along with the words and structures that are used in the realisation of these meanings.' They identify three components of such a register. Firstly, its *field* determines aspects of the context (e.g. the school environment) which is being reinforced by the mode of communication. For instance, Olson (1989) describes the textbook's role as acculturation within the authoritarian school structures. Secondly, the register's *mode* describes the function of the language used, i.e. the different language genres (Swales, 1990) teachers use when drawing on textbooks. Or, inversely the genres of written language of the book sections teachers select for use in class. Lastly, Halliday and Hasan (1976) identify the register's *tenor* dealing with the social interactions accompanying the communication medium.

In Namibia, the Ministry of Education prescribes, buys and distributes textbooks to schools. These, in turn, make texts available on loan to their learners. This system currently functions for science textbooks at secondary level (Tjikuua, 2000). However, a recent major evaluation of the education system in the country recommends as one way of private-public cost-sharing that parents purchase textbooks (GRN, 1999). This paper reports a study into the classroom usage of science textbooks. The findings will help focus teacher training programmes and curriculum development initiatives to optimise the use of a major resource, the textbook, in class. Findings may also contribute to the debate on the responsibilities for funding the purchase of science textbooks.

The research questions posed in this study are as follows:

- (i) how often do science teachers in Namibia use the prescribed textbooks in their classroom teaching?
- (ii) what are teachers' apparent purposes for using the prescribed textbooks in their teaching?
- (iii) how does the use of the prescribed textbooks differ for junior and senior classes?

Research Methods

Data on classroom activities were collected in 15 biology and 14 physical science lessons at Grade 10, 11 and 12 level for 12 teachers in 6 schools across Namibia. Grade 10 is the last grade of the junior secondary phase while grades 11 and 12 form part of the senior secondary phase. The sample included urban, peri-urban and rural schools. All teachers (nine of them female) were qualified to teach junior secondary science, and all were recently enrolled in the Mathematics and Science Teacher Extension Project (MASTEP). This project provides an INSET programme to upgrade teachers' content knowledge and pedagogy to prepare them to teach at senior secondary level. Three data collection methods were used. Oral classroom exchanges were recorded by an audio-tape-recorder placed near the front of the class. Secondly, a non-participant observer wrote a record of the lesson and made a note of learners' questions and answers in whole class oral exchanges and teachers' group interactions. Lastly, copies of the prescribed learner textbooks used during the lesson were collected. Triangulation of the data from the different sources endorsed the validity of the descriptions.

The content of each science textbook was analysed for the occurrence of various genres (Martin, 1993) and for different types of learning activities they support similar to the textbook content analysis by Peacock and Gates (2000). Each tape was transcribed verbatim and analysed for instances of reference to a student textbook. Reference to other resources, such as handouts and task instructions written on the board were included in this study only if they were copied from the book. By cross checking with observation records where required, each instance was classified in terms of aspects of field, mode and tenor. Here, grounded theory was used to determine descriptors of different aspects of each. Seven descriptors for classifying aspects of field, four descriptors for the mode and three descriptors for the tenor were developed. This process involved independent analysis by the authors followed by discussion to agree the descriptors for each aspect. There followed further independent analysis of the lesson transcripts to code each instance of a text book reference in terms of an aspect of each of field, mode and tenor. Comparison of the analyses and the easy resolution of the few (10%) differences that emerged demonstrated the reliability of the analysis. For each lesson, the frequencies were determined for references to textbooks, the originator (teacher or learner) of the references and of their classified field, mode and tenor.

Results

Textbooks in use in science classes

Science classes in this study used one of the prescribed textbooks. The junior secondary classes used texts locally written and produced after Namibia's independence in 1990: '*Life Science for Namibia, Grade 10*' (Nott *et al.*, 1997) and '*Physical Science for Namibia, Grade 10*' (Curry *et al.*, 2000) for Biology and Physical Science respectively. The senior secondary classes used imported texts usually with an older pedigree: '*GCSE Biology, 2nd edition*' (MacKean, 1995), '*Chemistry made clear, GCSE Edition*' (Gallagher and Ingram, 2000) and '*Physics for IGCSE*' (Foxcroft and Lewis, 1996), the first for Biology and the last two for Physical Science. All five books have been analysed for science teaching activities they support using the categories presented by Peacock and Gates (2000) and the genres used for science texts (Martin, 1993).

Analysis shows that all books were remarkably similar in their text genres. They extensively used the *report* genre, characterised by a style using generic participants, timeless verbs, with a proliferation of the verbs being and having. Definitions, classifications and, generally, the presentation of facts (the WHAT) were examples of the *report* genre frequently used in all books. As expected, all books also extensively used the *explanation* genre, characterised by a style using generic participants, timeless and mainly action verbs, with the presentation of actions in a logical order. Cause-and-effect descriptions, hypotheses and interpretations of observations or outcomes, in short, the presentation of explanatory relationships (the WHY) were examples of the *explanation* genre used in all books. All books also used the *experiment* genre characterised by a set of sequential imperatives and fixed stages (aim/method/apparatus/etc.) for presenting a practical activity. None of the books included fill-in worksheets to record activity outcomes. The remaining two scientific genres, i.e. argumentation and biography, were hardly used.

Only one of the two expressive genres were used in the science textbooks. The *narrative* genre, usually a story about an everyday event in non-scientific language, appeared in none of the books. However, all books included *questions* as a genre, both to help develop and assess learners' understanding, but not in order to diagnose learners' previous knowledge.

The use of textbooks in science lessons

Table 1 indicates the number of times the science teachers or their learners made references to the prescribed textbook. If learners were referred to handouts, not copied from the book, or exercises not included in the class text, these instances were not included.

Science subject and educational level	Number of observed lessons (lessons without reference)	Frequency of reference to book	Average frequency of reference to book per lesson
Biology: Junior Secondary	6 (-)	16	2.7
Biology: Senior Secondary	9 (3)	13	1.4
Physical Science: Junior Secondary	5 (1)	8	1.6
Physical Science: Senior Secondary	9 (4)	12	1.3
TOTAL:	29 (8)	49	1.7

Table 1. Frequency of references to the textbook in science classes

Table 1 indicates that in an average science lesson less than twice (1.7 times) some reference is made to the textbook. It is surprising that in more than a quarter of all lessons the book is not referred to at all. These lessons are not limited to specific teachers or schools. This proportion of non-use of the textbook is particularly high in senior secondary lessons (about 40%).

Type of use of the textbook

The usage of the textbook has been divided in three components. The divisions are based on the premise that the use of the textbook can be considered a particular register of communication (Halliday and Hasan, 1976). The first characteristic describing the use of the textbook is its 'field', i.e. the aspect of the school environment the communication intends to reinforce. In this study the 'field' is translated as the pedagogic purpose of the use of the textbook. The second characteristic describing the use of the textbook is its 'mode', i.e. the function of the language used in the book. In this study the 'mode' is interpreted in the narrow sense of the genre of the section of the text being referred to. Lastly, the use of the textbook is classified according to its 'tenor', i.e. the social interactions accompanying reference to the book in class.

Table 2 presents frequencies of the 'field' of book references as their pedagogic purposes in 7 different categories as listed in the first column. The remaining columns show the frequencies in which the various pedagogic purposes for textbook references have been used in Junior and Senior Secondary science classes respectively. Some textbook references can be seen to serve more than one type of pedagogic purpose. Thus the total frequency of pedagogic purposes may exceed the total number of textbook references.

Field: Type of pedagogic purpose	episode frequency in Junior Secondary lessons (n=24)	episode frequency in Senior Secondary lessons (n=25)	Total frequency (n=49)
1. to provide diagrams to support exposition or questions	10	11	21
2. to provide authority to teacher's exposition or mediate for differing views of learners	4	7	11
3. to read to consolidate or explore theoretical knowledge	5	3	8
4. to guide practical activities and the record of these activities	5	-	5
5. to set the teaching agenda	1	2	3
6. to provide a source for learners to copy text or diagrams from	1	2	3
7. to provide questions for learners to answer	-	3	3

Table 2: Frequencies of the types of pedagogic purposes the textbook is used for.

Table 2 shows that over 40% of the references to the textbook specifically use diagrams to support the teacher's exposition, or to form the basis of teacher's questions. This is equally the case for lessons at junior

and senior secondary level. Teachers used, for example, a table with metals sequenced according to their reactivity to ask about products of different metal-salt reactions; and a diagram of the heart to ask learners to explain why specific tissues are thick and others thin.

Just over 20% of the references used the textbook as the source of authority, either to back up the exposition of the teacher, or to help answering a learner's question. This happened more frequently at senior than at junior secondary level. For instance, at the end of a practical lesson aimed at determining the density of different substances, the teacher comments on the findings of a group as "I think this is correct, but the density of water seems to be Is there anybody here with a book? Any book. I think the density of water, I think is 1. Not 1,7, but 1." Or the situation where learners could not agree on the characteristic of arteries and veins.

T *What is the difference between the arteries and the veins?*

S *An artery is having a thin wall.*

T *An artery has a thin wall. Are you all agreeing, that an artery has a thin wall?*

S *No.*

T *You say no. What is your idea?*

S *A thick wall and a small surface area.*

T *A small surface area, a small room in it. Okay. Look in those diagrams in your book. On the right side of your body, the left side of your book. There are two drawings of the arteries and the veins.*

whispering

T *So the artery is having a thick wall, because Why is it having a thick wall?*

About 15% of the references to the textbook involved homework. Here the reference to the textbook served to consolidate theory dealt with in the lesson, or to explore content to be covered in the following lesson. No major differences between junior and senior secondary level seem apparent. About 10% of the references to the textbook involved worksheets for practical work photocopied from the book. This only occurred in junior secondary classes. The worksheets listed the steps for the practical procedures and included pre-printed tables for the observations. Thus the book was used to guide practical work and provide a structure for the report.

The mode of the use of textbooks in class

The mode of textbook use is equated here with the genre of the portion of text referred to in the book. Table 3 presents frequencies of the occurrence of different genres as reflected in the literature (Martin, 1993). The first column of Table 3 shows five scientific genres (report, explanation, experiment, argumentation and biography), and two expressive genres (narrative and questions). The remaining columns of this table show the frequencies in which these various genres have been used in Junior and Senior Secondary science classes respectively.

Mode: Type of genre	episode frequency in Junior Secondary lessons (n=24)	episode frequency in Senior Secondary lessons (n=25)	Total frequency (n=49)
<i>Scientific: report only</i>	10	11	21
<i>Scientific: explanation (with report)</i>	8	10	18
<i>Scientific: experiment</i>	5	-	5
<i>Scientific: argumentation</i>	-	-	-
<i>Scientific: biography</i>	-	-	-
<i>Expressive: narrative</i>	-	-	-
<i>Expressive: questions</i>	1	4	5

Table 3: Frequencies of the types of genres of the textbook sections referred to

Table 3 shows that no reference was made to textbook sections using argumentation, biography, or narrative as the genre. The referred sections of the book used mainly the report genre (including factual lists, classification descriptors or definitions) and the explanation genre (logically sequenced descriptions emphasising the inter-relationship of components including cause-effect relationships). Each of these genres was used for 40% of the textbook references. There is no difference for the two educational levels. Table 3 also shows that the experiment genre (using instructions and a prescribed format for reporting observations) was used in only 10% of the instances. This only occurred in junior secondary classes. Lastly, in another 10% of the references to the textbook the focus was on the question genre (the format for standard exercises). This genre mainly occurred at senior secondary level.

The tenor of the use of textbooks in class

The tenor of textbook usage describes the social interaction taking place when the textbook is referred to. The textbook was used by the whole class, a group in the class, or an individual. The textbook may be used at school or at home. Table 4 present frequencies of the occurrence of the different social interactions for the use of textbooks as observed in class.

Tenor: Type of social interactions	episode frequency in Junior Secondary lessons (n=24)	episode frequency in Senior Secondary lessons (n=25)	Total frequency (n=49)
1a. Teacher refers to the book to be used at school by individual learners	1	4	5
1b. Teacher refers to the book to be used at school by groups of learners	2	1	3
1c. Teacher refers to the book to be used at school by the whole class	14	16	30
1d. Teacher refers to the book to be used at home by individual learners	4	4	8
1e. Teacher refers to the book to be used at home by groups of learners	-	1	1
2a. Learner refers to the book to be used at school by individual learners	2	-	2
2d. Learner refers to the book to be used at home by individual learners	1	-	1

Table 4: Frequencies of the types of social interaction for the reference to the textbook.

Table 4 indicates that almost all references to the textbook were made by the teacher (categories 1a/b/c/d). The few occasions where learners mentioned the book occurred at junior secondary level. In about 60% of the cases (category 1c), the teacher invoked whole-class usage of the book. In only 10% of the cases (category 1a) the teacher directs individuals to the book (usually after they asked a question or provided an unacceptable response). In 15% of the cases (category 1d), the teacher refers to the book for individual home work.

Discussion

Frequency of using the prescribed texts in classroom teaching in Namibia

The data show that the textbook is not referred to at all in more than a quarter of all lessons, in 10% of lessons at junior secondary and almost 40% of the lessons at senior secondary level. In these lessons the book is not used to support class interactions, class work nor homework. Observations of this study provide no evidence that this non-utilisation is due to absence of prescribed textbooks. Textbooks are used in parallel classes in the same school, or subsequent lessons to the same class taught by the same teacher. This means that reference to the book is a pedagogical decision, not a decision determined by the availability of resources. This striking non-utilisation of textbooks indicates a considerable wastage of valuable and scarce investments.

The frequency of referring to the textbook in the remaining lessons is low. The prevailing teaching practice in classrooms in Southern Africa depends on oral interaction using exposition (MacDonald and Rogan, 1990) and elicitation through superficial and factual question-and-answer techniques (Arthur, 1998). Such pedagogical styles do not lend themselves to involving texts during class. Any training schemes aimed at improving the use of the textbooks, should simultaneously focus on the role of the teacher in the learning and teaching process.

The frequency of teachers' references to the textbook is much higher at the junior secondary than at the senior secondary level. This may well reflect the difference in the nature of these books. The textbooks for junior secondary level have been generated locally and are contextualised for the Namibian curriculum. As part of a massive post-independence in-service programme, junior secondary science teachers have contributed to the refinement of the textbooks and have been trained in the use of these books (Tjikua, 2000). This seems to indicate that the inclusion of a module on textbook usage in the current upgrading programme (MASTEP) may considerably increase the efficiency of the use of resources at senior secondary level. Also, continuous professional development initiatives may centre around small-scale material development by clusters of teachers using the prescribed textbook as a starting point.

Purposes for which textbooks are used in classroom teaching in Namibia

It is reassuring that teachers use correctly drawn and labelled diagrams from the book as props for their exposition and questions, rather than an often hastily drawn and inaccurate version copied on the board. However, the book is used infrequently for other text-based classroom activities, such as text comprehension, definition of terms, data interpretation, small group discussion tasks, practical activities, etc. The use of the book for setting homework tasks and for mediation for differing learners' views suggests that teachers consider the book as an authoritative precipitation of the required science content knowledge (Luke *et al.*, 1989), rather than a resource for learning activities. This limited view of the textbook as a consolidation of fixed knowledge constrains the possibilities of providing learner-centred education where learners construct their own meaning and develop critical thinking skills. Teacher education programmes need to emphasise the use of textbooks as opportunities for learners to take charge of their own learning.

Pedagogical purposes for which the textbook was used differ only marginally for junior and senior secondary level. At senior level the book is more often referred to as an arbiter for conflicting learner understanding, or for confirming the teacher's exposition. This difference is expected as the teachers in the sample have not been trained to teach at senior level, and acknowledge themselves having a shaky content knowledge. Their uncertainty about science content and required syllabus depth may also explain the greater reliance on the book for senior secondary teachers for set exercises to evaluate learners' understanding. The frequencies of the types of genres teachers refer to in the book reflects, on the whole, the genres available in the books.

The findings of this study indicate that the presence of a prescribed textbook is no guarantee for its efficient and imaginative usage. Further research needs to identify teachers' reasons for using textbooks in the way they do, and how teachers' usage of textbooks relates to their previous training. Although there is evidence that the provision of textbooks is one of the most powerful tools in improving the output of education (Walberg, 1991), we still need to answer the question how this improvement is related to the various ways textbooks are used.

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