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Teacher–Textbook Relationships in Mathematics in Contexts of Limited Resources

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This paper examines how seven teachers working in contexts of limited resources used the prescribed textbook for teaching, and the kinds of teacher–textbook relationships forged in the interactions. The study employs a sociocultural perspective to explore the processes by which teachers mobilise the affordances of the textbook to the teacher’s practice, thereby advancing a particular way for studying and understanding better the teacher–textbook relationships in particular contexts. A methodological approach aggregating results for all teachers and looking for patterns of mobilisation across teachers allowed for the analysis of patterns of mobilisation regardless of the teacher. Findings point to generally tacit use of the textbook and a need for intervention on textbook use by teachers. The study makes recommendations for the production of educative guides as well as further research on the perceived role of the textbook in the teacher’s practice.

Keywords: Teacher–text relationships; textbooks; affordances; pedagogical design capacity; omissions; injections; offloading; improvising

Introduction

In contexts of limited resources, both material and knowledge as depicted in schools and classrooms of the majority of teachers in South Africa, the question becomes: how does the textbook support teachers’ practice and how do teachers use these supports to open up opportunities for effective mediation in their classrooms? The current rhetoric in South Africa about mathematics education is that it is in crisis. This crisis has been partly attributed to the quality of teachers and partly to policy (Shalem & Hoadley, 2009; Spaull & Kotze, 2015). Some efforts to combat the crisis include instituting of several Mathematics Education Chairs led by prominent academics and funded from private sector at public universities from 2010. These Chairs conduct professional development activities for teachers in both primary and secondary schools. The present study emerged from one such project, the Wits Maths Connect Secondary Project. While the study concurs that strengthening teachers’ knowledge is paramount to improving the quality of teaching, it also notes another critical aspect of teachers’ practice that concerns curricular resources for teaching, textbooks.

In South Africa, however, this is an aspect that has been little researched, even though the textbook remains a major resource for teaching for the majority of teachers. The current study is one of very few in the field of research on textbooks in South Africa, and therefore a welcome addition to the literature in the field that is growing rapidly internationally (Fan et al., 2018). Adler (2000) made a self-explanatory declaration about the role of resources in educational practice and therefore, the importance of this study, when she wrote: ‘that educational practice is a function of available resources needs neither advocacy nor explanation’ (p. 206). Her views echo those of other researchers who have shown the interconnectedness of mathematics teaching and the textbook (Hodgen et al., 2010;

Valverde et al., 2002). Internationally, the field of research on textbook use and development features different categories (Fan et al., 2013), and therefore it is imperative to outline the focus of the current paper from the outset as elaborated in the next section.

Research on Teacher–Textbook Relationships

This paper investigates the interactions between the teacher and the textbook and the kinds of teacher–textbook relationships forged from these interactions. Teacher–textbook relationships occupy only about 25% of the field of research on textbooks that is dominated by textbook analysis and comparison (Fan et al., 2013). One important cause of this discrepancy is the acknowledgement of the complex nature of the interactions between the teacher and the textbook. Remillard and Kim (2020) posit that ‘even in settings where teachers feel compelled to follow their adopted curriculum programs closely, they bring their own meanings to these tasks, influenced by their local knowledge and commitments’ (p. 10). Thus, teachers use textbooks in varied and quite individualistic ways, from selection to implementation. Remillard (2005) highlights four major conceptualisations of textbook use as: fidelity to the textbook, subverting the textbook, interpretation of the textbook and participation with the textbook. The current study, as most studies in this field, aligns itself with the latter perspective. This perspective is a recognition of the dialectic nature of the interactions between the teacher and the textbook in which each influences the other, and a deep appreciation that the enactment in the classroom is a result of the influence of both (Fan et al., 2018).

Theoretically, the research is grounded in sociocultural theory and mediated action, emphasising the agent–tool interrelationships (Vygotsky, 1978; Wertsch, 1998). Textbooks mediate the teachers’ practice through characteristics that have capacity to extend or constrain this practice. Teachers mediate the textbook to learners and hence are regarded as designers of the enacted curriculum (Brown, 2009; Gueudet & Trouche, 2009; Remillard, 2005). The interaction between teacher and textbook results in transformed features of each participant that influence the final product for enactment in the classroom. Thus, teacher–textbook relationships depict a shared agency between the teacher and the textbook. The current article explores how the teachers in the study forge relationships with the textbooks they use for teaching in their classrooms. The study acknowledges that teachers might utilise different resources for teaching; however in this case, the focus is only on the prescribed textbook. The teachers in the study have admitted to utilising the same textbook as their major resource for teaching. Furthermore, while the study acknowledges the existence of both affordances and constraints in the textbook, the focus in this article is only on the affordances of the textbook to the teachers’ practice. Affordances in this study pertain to those qualities/features of the textbook deemed beneficial for the teacher’s practice: what the textbook affords the teacher’s practice. The paper has deliberately stayed away from the debates about Gibsonian vs Norman ‘affordances’ (see McGreener & Ho, 2000). This perspective of affordances allows for the association between the appropriation of the affordances by the teacher and the opportunities for mediation that teachers open up in the classroom.

The specific questions for this article are as follows:

- How do teachers mobilise the textbook affordances for teaching?
- What kinds of relationships do teachers forge with their textbooks?

Textbooks as Mediators of Teachers’ Practice

In recognition of the important role of textbooks in the curriculum, Valverde et al. (2002) place the textbook between the *intended curriculum* and *implemented curriculum* in their tripartite model of curriculum, referring to textbooks as the *potentially implemented curriculum*. As the authors stipulate, textbooks are a translation of curriculum policies of a country as intended by their authors and editors, thus ‘providing an unchanging reference to the nature of [these] school subjects for teachers, students, and their parents’ (p. 1), for the duration of their use in schools. Research in the field indicates that pedagogic instructions for each textbook have been embodied in its *structure*, that is, in the

way it is organised and in what it contains (Brown, 2009; Remillard, 2012; Valverde et al., 2002): the *content* and the *approach* to teaching.

For Valverde et al. (2002), the approach of a textbook is determined through how it sequences both the *presentation formats* (partitioning blocks) of content, and learners' *performance expectations* (actions on tasks expected of learners). The sequencing of presentation formats reflects a general approach to teaching that the textbook advances while that of performance expectations reflects a particular conceptualisation of the concept being taught. In South Africa specifically, Ensor et al. (2002) point to two pedagogic approaches that dominate textbooks as the *inductive* approach, that is investigative, and a more didactic *deductive* approach. Drawing from the literature above, Leshota (2019) developed a framework for determining affordances of textbooks, presented in Figure 1.

Figure 1 depicts major affordances of the textbook as the *mathematical content* and the embedded pedagogic *approach*. The organisation for the mathematical content illuminates the *nature of the mathematics content* or the main mathematical *content areas* covered, while the sequencing reflects how the content areas have been ordered. With respect to the *approach* of the textbook, content is organised into *presentation formats* and *performance expectations* of the learner. The sequencing of presentation formats indicates whether the approach to teaching adopted by the textbook is *quasi-deductive* or *quasi-inductive*. A quasi-deductive approach commences with a *definition* of a concept, which is exemplified through one or more *worked examples*, and then followed with *practice exercises* for learners. In contrast, the quasi-inductive approach begins with an investigative *activity* that provides learners with an opportunity to make conjectures before the textbook elaborates on the concept with *notes* and *illustrations*. *Worked examples* and *practice exercises* then follow. The sequencing of performance expectations of learners highlights how a particular topic under discussion has been conceptualised. In this study, the topic was *Functions*, and so the sequencing of performance expectations illuminated whether the conceptualisation of Functions was pointwise or global (Even, 1998). The pointwise perspective focusses on point-by-point actions such as plotting and reading off values from the graphs, while the global view considers the holistic behaviour of *Functions*. The analysis of a Grade 10 textbook series using this framework (Leshota, 2015, 2019) yielded the results shown in Table 1.

The first column of Table 1 shows that the textbook afforded four mathematical content areas, namely, *notation and terminology*, *properties of Functions*, *transformation of Functions* and *interpretation and application of Functional properties*. The sequencing of presentation formats under these content areas in the second column shows a quasi-deductive approach (didactical) when dealing with the notation and application of *Functional* properties. For determining properties and transforming *Functions* the textbook advanced an investigative, quasi-inductive approach. With respect to the

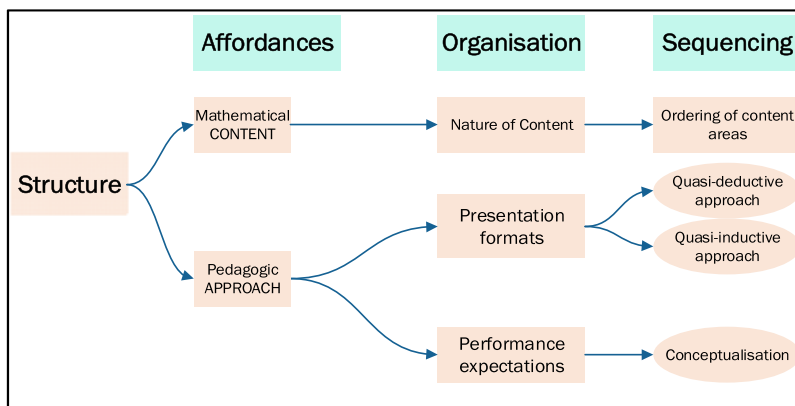


Figure 1. A framework for analysing affordances of a mathematics textbook (source: Leshota, 2019)

Table 1. Results of affordances of a textbook to the teachers' practice

Mathematical content area (arranged sequentially)	Sequencing of presentation formats	Sequencing of performance expectations of learners
Notation and terminology	Quasi-deductive	Pointwise
Properties of <i>Functions</i>	Quasi-inductive	Progression from pointwise to global
Transformation of <i>Functions</i>	Quasi-inductive	Global
Interpretation and application of <i>Functional</i> properties	Quasi-deductive	Global

sequencing of performance expectations, the textbook conceptualisation started with a pointwise strategy for notation that progressed towards a fully global conceptualisation of *Functions* by the time it got to the interpretation and application of *Functional* properties. These are in fact results of the textbook used by the teachers in the current study, and shall therefore be used as indicating affordances of the prescribed textbook to the teachers' practice in the current article. The article hence investigates how the teachers mobilise these particular affordances of the textbook. The next section reviews the literature on how teachers interact with the affordances of the textbook.

How Teachers Mobilise Textbook Affordances

Growing research on teachers' pedagogical design capacity or PDC (Brown, 2009), a skill by which teachers perceive and mobilise textbook affordances, has shed light on the processes by which teachers transform these affordances into productive classroom offerings (Pepin et al., 2017; Remillard, 2018). This means that there would be different designs, some more effective than others depending on individual skills of the teachers. For example, Leshota and Adler (2018) show that teachers omitting critical elements of the object of learning affects the teacher–textbook relationship adversely. Furthermore, research suggests that steering instruction towards the mathematical point is crucial to the teacher–textbook relationship, especially with innovative resources (Remillard & Kim, 2017; Sleep, 2012). Effective mobilisation of textbook affordances by the teacher presupposes alignment of the affordances with various teacher features, specifically, their beliefs, knowledge, orientation and goals (Brown, 2009; Pepin et al., 2017; Remillard, 2005). And so, (mis)alignment of teachers' and textbooks' goals (Choppin et al., 2018) is critical to how teachers transform the textbook.

One of the models of teacher mobilisation of affordances is presented by Brown (2009), who depicts teachers' appropriation of affordances as lying on a continuum. At one end, teachers *offload* the agency of the lesson to the textbook, while on the other end they *improvise* all of the lesson from resources other than the textbook. In the middle, teachers *adapt* the textbook affordances by sharing the responsibility for the delivery of the lesson equally with the textbook. However, the degree of appropriation does not indicate teachers' quality of PDC, that is, their quality of mobilisation, but only the quantity of textbook use; hence a need for an in-depth analysis of the mobilisation. To illustrate this, Leshota and Adler (2018) conducted an in-depth exploration of teacher Mpho's mobilisation of affordances by distinguishing between the kinds of *omissions* and *injections* Mpho made in her lessons, presented and described in Table 2. Injections pertain to content that is not available in

Table 2. Categorisation of omissions and injections

Indicator	Categories	Description
Omissions	Productive	Content omitted which does not detract from opportunities for mediation
	Critical	Content omitted from lessons that is critical to opportunities for mediation
Injections	Robust	Injections of content which enhance opportunities for mediation of the object of learning
	Distractive	Injections of content which detract from opportunities for mediation

the textbook, but which the teacher injects into the lessons. Omissions represent content that is available from the textbook but which the teacher leaves out during teaching.

As Table 2 shows, *critical omissions* and *distractive injections* detracted from opportunities for mediation in the classroom, and could therefore be harmful to teacher–textbook relations. However, *robust injections* and *productive omissions* did not detract from opportunities for mediation. The authors used these categories and their combinations as a framework to characterise: (i) the kind of *textbook use* by the teacher; (ii) the kind of *teacher–resource relationship* forged; and (iii) the *level of PDC*. They concluded that only a combination of productive omissions and robust injections yielded high levels of PDC and therefore intimate teacher–resource relationships. This was the only combination indicative of deliberate and participatory textbook use vs a tacit (Polanyi, 1967), or taken-for-granted, textbook use in all the other combinations of omissions and injections. This framework shall be utilised to determine the kinds of relationships teachers forge with their textbook in this article.

Methodology

The study involved seven Grade 10 teachers from three schools, and focussed on the topic of Functions. This was a convenient sampling constituting teachers from one of three clusters of schools participating in a professional development programme. All the Grade 10 teachers in this cluster were invited to participate in the study, and they agreed. The *Classroom Mathematics* textbook series (Pike et al., 2011) was used for the study as all schools had adopted the series as their prescribed textbook at Grade 10. The teachers and all their learners who did not have the textbook were provided with copies before data collection commenced. Furthermore, since the study took place during the transition from the NCS¹ curriculum to the new CAPS² curriculum, the author of the relevant chapters in the new textbook (and coincidentally, the old textbook) agreed to provide all of the teachers with the draft chapters to use if they needed to do so. A workshop was organised for the author to present the new materials to the teachers and describe the differences between the old and new chapters. It is noted that, while the textbooks changed, the curriculum on Functions from the NCS to the CAPS curriculum did not change, and therefore the two editions of the textbook covered the same curriculum content.

The data for this article entails three classroom observations for each of six teachers and two for the seventh teacher owing to timetable clashes, producing 20 video recordings that were transcribed in preparation for data analysis. Field notes taken by the researcher before, during and after the classroom observations supplemented the data. For data analysis, a naming system that assigned letters and numerals to the schools, teachers and lessons to cater for anonymity and the variables in the data was adopted. For example, each school was allocated a letter, A, B or C, and in each school, depending on the number of teachers, a numeral was designated to each. Thus, in school A with four teachers, the teachers were referred to as A1, A2, A3 and A4. The three lessons for teacher A1 were labelled, A11, A12, A13, and so forth. The analysis of the lessons was conducted in two stages, commencing with the appropriation of the mathematical *content*, and then the appropriation of the *approach*. Each lesson was chunked into analysable episodes, and indicators for each of the appropriation of *content* and *approach* identified and coded accordingly. When all analyses were completed, the results for all 20 lessons were aggregated, and patterns of appropriation across lessons and teachers established regardless of the teacher. The process of data analysis shall be reported separately for the *content* and the *approach* in the next section, starting with the content.

Analysis of the Appropriation of Mathematical Content

Three indicators were considered for the appropriation of the mathematical *content*, namely, *coverage*, *degree of appropriation* and *opportunities for mediation*. Firstly, the analysis determined the extent of coverage for the four content areas (CAs) as stipulated in the curriculum and identified in the textbook. The CAs, numbered according to how they followed one another in the textbook, were: *notation and terminology* (CA1); *properties of Functions* (CA2); *transformations* (CA3); and *interpretation and application of the properties* (CA4). In each episode, the CA covered was indicated.

In some lessons, there was more than one CA covered over different episodes. This was indicated as well, which meant that there were more CAs recorded than the lessons.

For the second indicator, the *degree of appropriation of content*, Brown's (2009) descriptions of *offloading*, *adapting* and *improvising* were recruited. Each lesson was analysed for whether the content was offloaded 'as is' from the textbook, (O^+), or completely improvised from other resources (I^+). Where there was evidence of a combination of offloading and improvising, the superscripts, + and -, were used to indicate more of (+) and less of (-). For example, the code (O^+I^-) would indicate a situation where the teacher employed more of offloading than improvising in the same lesson, and vice versa for (I^+O^-). An adapted lesson, in which the offloading and improvising were more or less the same, was indicated with the code (I^+O^+).

The third indicator, *opportunities for mediation*, was adopted from Leshota and Adler (2018). This indicator entails the constructs of *injections* and *omissions*. The analysis determined whether the injection the teacher made in the lesson was *robust* and enhanced the lesson (inj^+) or *distractive* (inj^-). It also indicated omissions that were *productive* (om^+) and did not detract from opportunities for mediation, vs *critical* omissions (om^-), which were considered to be distractive as they left out critical elements of the object of learning.

Analysis of the Appropriation of the Approach

Data analysis for the approach entailed two aspects. Firstly, the analysis determined the teacher's general approach to teaching and compared it with the textbook's on the same CA. Adopting analytic tools used for teacher Mpho's appropriation of the approach of the textbook (Leshota & Adler, 2018), the analysis determined whether the teacher's general approach to teaching in each lesson was *quasi-deductive*(QD), that is, didactic and telling, or *quasi-inductive*(QI) and investigative. Then, comparisons of the approach of the teacher and that of the textbook were made. For example, if the teacher's approach was similar to the textbook's, that approach was indicated with a tick ($\checkmark$) and when the two approaches were different it was indicated with a cross ($\times$). For each of the quasi-inductive and quasi-deductive approaches, therefore, there were two codes to indicate the similarity with the textbook's or the difference, namely, $QD\checkmark$, $QD\times$, $QI\checkmark$ and $QI\times$.

The second aspect of analysis pertained to the conception of Function advanced in teachers' lessons. Recruiting Even (1998), the analysis determined whether the approach to Function was on a point-by-point (pointwise view) basis, or a global view looking at how a change in one variable leads to changes in other variables. While flexibility to shift between the two views as needed is recommended and was observed in the lessons, the study specifically looked for an indication of progression from pointwise strategies to global strategies that considered the overall behaviour of the *Functions*. Such a progression signals a recognition of general patterns for different *Functions* classes and their transformations. Similarly to a general approach therefore, a comparison of the textbook's and teachers' conceptions was indicated, producing two codes for the pointwise view ($Pt\checkmark$ and $Pt\times$), two for the global view ($Gl\checkmark$ and $Gl\times$) and, one for the progression from pointwise to global view ($Pt-Gl$). The next section reports the results of the analyses.

Results

All results of the analyses of the appropriation of both the content and the approach are presented in Table 3 to enable cross-referencing and generalisation. The first two columns show each lesson and the week in which the lesson took place. The next three columns represent the indicators for the appropriation of the content and the last two columns show the adoption of the general approach and conceptualisation of Functions. The blank spaces in column 5 (opportunities for mediation) indicate that, in those lessons, there were no apparent omissions or injections of content. The content and approach are reported separately next, commencing with the content.

Table 3. Teachers' mobilisation of textbook affordances

Lesson		Appropriation of content			Appropriation of approach	
Number	Week	Coverage	Degree of appropriation	Opportunities for mediation	Degree of adoption of general approach	Conception of <i>Function</i>
A11	1	CA1	$O^+ I^-$	inj^+ om^+	$QD^✓$	Pt✓
A12	1	CA3	I^+	inj^+	$QI^✓$	Pt–GI
A13	3	CA4	O^+	om^- om^+	$QD^✓$	Pt–GI
A21	1	CA1	$O^+ I^+$	inj^-	$QD^✓$	Pt✓
A22	2	CA2	O^+	om^-	$QD^×$	Pt×
A23	3	CA2	I^+	inj^-	$QD^×$	Pt×
A32	2	CA3	I^+	inj^+	$QD^×$	GI✓
A33	3	CA4	$I^+ O^-$	om^-	$QD^✓$	Pt–GI
		inj^+		$QD^✓$	GI✓	
				$QD^×$		
A34	3	CA2	O^+	inj^+	$QD^×$	GI✓
		CA4			$QD^✓$	
					$QD^✓$	
A41	1	CA1	$I^+ O^-$		$QD^✓$	Pt✓
A42	3	CA2	$I^+ O^-$	om^-	$QD^×$	Pt–GI
A43	3	CA2	I^+		$QD^×$	GI✓
B11	1	CA3	I^+	inj^+	$QI^✓$	Pt–GI
B12	2	CA3	I^+	inj^+	$QI^✓$	Pt–GI
		CA4			$QI^×$	
B21	1	CA1	I^+		$QI^×$	Pt✓
		CA2			$QI^✓$	Pt×
B22	2	CA2	$I^+ O^-$	om^-	$QD^×$	Pt–GI
B23	4	CA4	I^+		$QD^✓$	Pt✓
C11	1	CA2	I^+		$QD^×$	Pt–GI
C12	2	CA2	$I^+ O^-$	inj^+	$QD^×$	GI✓
				om^-		
C13	3	CA2	$O^+ I^+$		$QD^×$	GI✓
		CA4			$QD^✓$	
			20	18	27	22

Appropriation of Content

Each one of the elements of appropriation of content analysed, namely, coverage, degree of appropriation and opportunities for mediation made available in the classroom, is reported separately in this section, followed by a consolidation of all results.

Coverage

Table 3 shows three important results pertaining to coverage. Firstly, the majority of teachers were able to cover the four CAs within the four weeks, with the exception of two teachers, A2 and A4, whose lessons went only as far as CA2. Secondly, the teachers generally followed the ordering of CAs from CA1 to CA4 as observed in the prescribed textbook, depending on when the first lesson was observed. Finally, as shown in Figure 2, teachers gave more attention to CA2 (properties of *Functions*) than all the other CAs in the lessons. CA2 occurred in 41% of lessons, followed by CA4 (interpretation and application) at 29%, and then both CA1 (*Function* notation) and CA3 (transformations) at 15%. In other words, in this study, the teachers were observed teaching about properties of *Functions* more than any other CA, even though all of the CAs were observed over the four-week period.

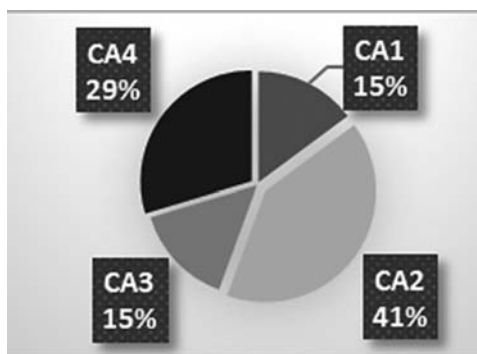


Figure 2. Coverage of content areas (CAs)

On the Degree of Appropriation of Content

The degree of appropriation was analysed to indicate whether for each CA the teacher used more of content from the textbook or from external resources. The results from Table 3 have been summarised in Figure 3.

From Figure 3, 15% of the lessons were *offloaded* (O^+) 'as is' from the textbook, while 10% were *adapted*. In lesson C13, the teacher assigned classwork from the textbook, and used past examination papers for consolidation work. This was considered an adapted lesson as it utilised the textbook and an external resource more or less equally. Figure 3 also shows 45% of lessons which were *improvised* (I^+). Teachers used more content from external resources than the textbook in these lessons. To determine the effect of the parameters a and p in $f(x) = ax^2$ and $g(x) = ax^2 + p$ in Lesson B11, the graphs of $y = x^2$, $y = 2x^2$, $y = 1/2x^2$ were drawn on the same set of axes followed by $y = -x^2$. The textbook handles these transformations differently. The graphs of $y = x^2$, $y = 3x^2$ and $y = 1/2x^2$ are drawn on the same set of axes, and have to be matched with an appropriate *Function*. The same approach is used for the reflections over the x -axis, with the graphs of $y = -x^2$, $y = -3x^2$ and $y = -1/2x^2$. Only negative values for a are used for $g(x) = ax^2 + p$. Lesson B11, hence, was considered an improvised lesson since the teacher improvised external material and the approach even though the textbook contained similar content. In general, there was more improvisation than offloading in the 20 lessons. In fact, all teachers had at least one improvised lesson, sourced from professional development workshops on Functions or from commercial workbooks.

On the Opportunities for Mediation

Table 3 shows that *omissions* and *injections* were made in 18 of the 20 lessons: 10 injections and eight omissions. Eight of the injections, that is, injections of content not yet required by the curriculum, were *robust*, meaning they enhanced the lessons, while two were *distractive*. The two distractive injections came from one teacher, and could be attributed to the teacher's subject matter knowledge. The robust injections included *horizontal shifts* in the transformation of *Functions* which are required at Grade 11. Horizontal shifts were discussed in professional development workshops to contrast $f(x) = x^2 + 1$ and $g(x) = (x + 1)^2$. The other robust injection involved the *vertical line test*, which is widely used to distinguish *Functions* from non-*Functions* worldwide. This test is not included in the prescribed textbook.

With respect to the omission of content that is included in the textbook, six were *critical omissions* while two were *productive*. The productive omissions entailed omitting some exercises from a given set owing to

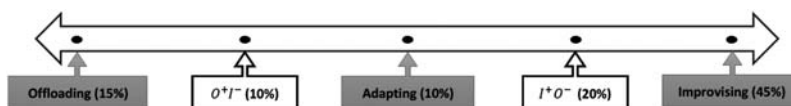


Figure 3. Degree of appropriation of content

time constraints. However, those omissions did not detract from the object of learning. The omissions which were critical occurred in six of the seven teachers' lessons and all included disparities in the handling of properties of *Functions*. In lesson A32, $a = -1$ only was used to explore the effect of a , in $y = ax^2$, even though the textbook used other values including fractions and numbers greater than 1 to illustrate the effect of a . This was critical as it gave an impression that the effect of a is always a reflection over the x -axis. In lesson A42 on the properties of the exponential *Function* the asymptotic behaviour of the *Functions* did not form part of the discussion on the properties even though this property is considered critical for this particular *Function* class. In all of these cases, there was no evidence that the omissions were rectified at a later stage, suggesting that learners in those classrooms proceeded to the next level without being exposed to these critical features of some *Function* classes.

In summary, teachers generally covered the CAs in the order suggested in the textbook. They used more content from external resources than the content in the textbook, while making robust injections that enhanced their lessons. However, all but one teacher also made critical omissions in their lessons, which detracted from opportunities for mediation.

Appropriation of the Approach

The appropriation of the textbook's approach considers the general approach to teaching and the approach to the conception of Function.

On the Degree of Adoption of the General Approach to Teaching

Figure 4 summarises the results for the appropriation of the general approach from Table 3. Figure 4a shows a prevalence of the quasi-deductive approach at 71% to the quasi-inductive approach at 29%. In other words, the teachers in the study mostly utilised a didactic and 'telling' approach more than the investigative approach, contrary to the textbook's approach. As shown in Figure 4b, for CA1 and CA4, the largest portions of their bar charts correspond to a quasi-deductive approach that is similar to the approach of the textbook. Similarly, for those teachers who taught CA3, they used more of the quasi-inductive approach as used by the textbook. Major differences occurred with CA2 where the modal approach, which was quasi-deductive, corresponded to 10 out of 11 lessons which were different from the textbook's approach. This means that teachers used the same approach as the textbook in only one out of the 11 lessons. In the other 10 lessons, teachers used the quasi-deductive approach whereas the textbook had advanced a quasi-inductive, investigative approach for this content. For the appropriation of the general approach to teaching hence, there was more alignment of the approach between the teachers and the textbook where the approach was quasi-deductive, but not much where the approach of the textbook was quasi-inductive.

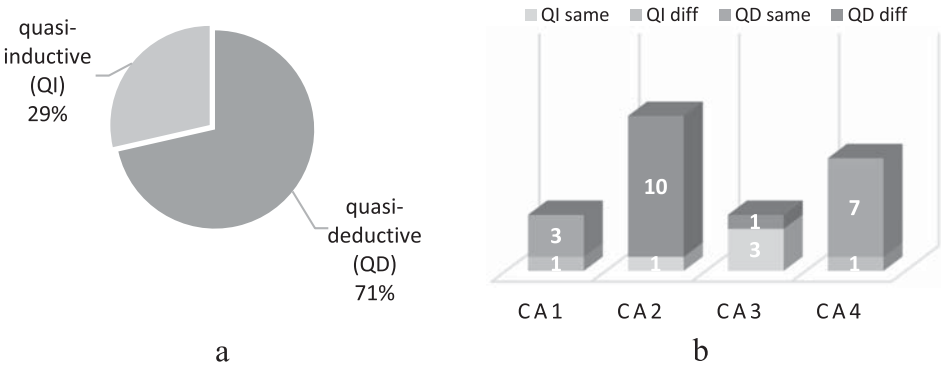


Figure 4. (a) Quasi-inductive vs quasi-deductive approaches and (b) approach per CA

On the Degree of Adoption on the Approach to the Conception of Function

From Table 3, eight pointwise (Pt) strategies were counted, five matching with the textbook (Pt✓) and three not matching (Pt×). All three mismatches occurred under CA2 and related to the pointwise approach. Two teachers used the pointwise approach to determine the properties of *Function* classes instead of progressing from pointwise to the more holistic approach as the textbook did. For the rest of the teachers, however, they used the same approach to the conception of *Function* to that used by the textbook for the specific CAs. Thus, all in all, for teaching Functions specifically, there was a greater alignment between the approach used by the teachers and that of the textbook.

Discussion

How did the teachers in the study mobilise the affordances of the textbook? A strong relationship between the teachers and the textbook was evident. Firstly, the CAs were covered within the four allocated weeks of *Functions* in the annual teaching plan and in the order from CA1 to CA4. Secondly, there was ample evidence indicating that the teachers used their prescribed textbook for teaching. Except for one, all of the teachers taught one or more lessons in which offloading occurred. This was not surprising in the current context where textbooks have been aligned to the curriculum and preapproved by government. As Valverde et al. (2002) posit, textbooks translate curriculum policies of a country into representations for the classroom.

However, there were some important surprises. Results showed more improvised than offloaded lessons, meaning that, even though the same content was available in their textbooks, the teachers overlooked these and instead drew most of the content in the lessons from external resources. Most importantly, while 45% of injections teachers made were enhancing to the lessons, a positive development towards enabling teacher–textbook relationships, the fact that all the six teachers who used the prescribed textbook had at least one critical omission made raises a concern about the kinds of relationships teachers forge with their textbooks. What and how content is used for the classroom is the teacher's prerogative, but, in contexts of limited material and knowledge resources in which the study took place, expectations are that the textbook would provide support and guidance to the teacher. When critical features explicitly stated in the textbook are ignored by the teacher, it reflects what Leshota and Adler (2018) term a tacit or taken-for-granted use of the textbook, an indication of a non-participatory relationship between the teacher and the textbook.

Furthermore, the teachers' affinity towards a quasi-deductive, didactic approach shown in the lessons was not a surprise as Ensor et al. (2002) noted the prevalence of the deductive pedagogy in their study. However, teachers' ignoring of the quasi-inductive approach shows a misalignment of goals (Choppin et al., 2018) between the teachers and the textbook, thus raising questions about opportunities for mediation that teachers open up for learners with respect to the properties of *Functions*. This misalignment could be a reflection of the teachers' inability to perceive the affordances of the textbook, but it could also be the inability of the textbook to respond to the teachers' needs. Whichever the case, it points to some form of breakdown in communication between the teacher and the textbook.

Conclusion

The study raises some important questions for further research pertaining to teachers' use of the textbook and the subsequent relationships forged between them. It is most important to understand why teachers did what they did when using the textbook. Secondly, what do teachers perceive the role of the textbook in their practice to be? One of the limitations of this article is the lack of teachers' voices, which could have provided some explanations for the teachers' actions. Similarly, the article did not consider the constraints of the textbook. However, despite these limitations, the article has highlighted important considerations for the teacher–textbook relationships, topmost being the need to develop and strengthen teachers' capacity to perceive the affordances (and constraints) of the prescribed textbook. A C2005³ study affirms a need for educating teachers to use textbooks appropriately, especially

in contexts of limited resources which, as the study points out, challenge even the most experienced teacher (Czerniewicz et al., 2000).

Furthermore, the study reflects that teachers are using a learner textbook for teaching which was not designed for that purpose. A growing field of research on *educative* materials (Davis & Krajcik, 2005; Davis et al., 2017) which are designed with features to guide the teacher, advocates and outlines heuristics for designing such materials. In contexts of limited resources, this study highlights a need for *re-sourcing* (Adler, 2000) the teachers' practice with educative materials specifically designed to guide them.

The study has further highlighted a methodological contribution to the analysis of teachers' mobilisation of textbook affordances. By aggregating the 20 lessons and looking for patterns across them, it became possible to draw conclusions about teachers' processes of mobilisation of affordances, irrespective of the teacher.

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Notes

1. NCS is the National Curriculum Statement instituted in 2005.
2. CAPS is the Curriculum and Assessment Policy Statement instituted in 2011.
3. C2005 stands for Curriculum 2005 that was instituted in South Africa between 1998 and 2000.

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