

Chapter 8

Using Social Semiotics to Explore Institutional Assumptions About Mathematics Students and Teachers

Candia Morgan

Abstract In this chapter I present some theoretical principles and analytical tools of social semiotics, discussing how they may contribute to mathematics education research. Two examples are offered. The first shows how the way an examination question is written construes the nature of mathematical activity; I consider how this may function for different students. The second example uses thematic analysis to look at a corpus of official documents, asking what activities are made available in these texts for teachers and students.

Keywords Social semiotics · Thematic analysis · Systemic functional linguistics
Official discourse · School mathematics practices

8.1 Introduction

Mathematics education as a field has a wide range of concerns, but most semiotic research has tended to focus on analyzing students' mathematical understanding and its development, including analysis of student-teacher-tool interactions. Radford's cultural historical semiotic approach situates sign use and knowledge production within a cultural context, but research from this perspective also focuses primarily on teaching and learning processes and interactions, on the nature of mathematical knowledge and on the development of mathematical thinking (e.g., Radford 2003). Less attention has been paid to how a semiotic perspective can provide insights into the wider context of mathematics education and how this may affect the experiences of student and teachers.

The teaching and learning interactions of students and teachers take place within schools and colleges that are themselves situated within local and national education systems, national and international policies and discourses about mathematics

C. Morgan (✉)

Department of Curriculum Pedagogy and Assessment, University College
London Institute of Education, 20 Bedford Way, London WC1H 0AL, UK
e-mail: candia.morgan@ucl.ac.uk

and about teaching, learning, curriculum and assessment. The field of mathematics education research needs to address all of these sites, seeking to understand the concerns and practices of all those involved in their various ways with mathematics education and the relationships between them—while recognizing that it is likely to be necessary to focus on only a small part of the complex at any one time (Morgan 2014; Valero 2010). In this chapter I hope to contribute to this project of researching the wider complex of social practices of mathematics education by discussing a semiotic perspective that offers some theoretical and analytical tools, and by offering examples of analysis that can provide insight into how teachers and students of mathematics and the ways they experience mathematics teaching and learning, may be shaped by the institutional context in which they are situated.

The approach that I am adopting here is founded in social semiotics (Halliday 1978; Hodge and Kress 1988; Morgan 2006). Fundamental to this theoretical perspective is the principle that language and other modes of communication (including visual images, gestures, specialized forms of mathematical notation, etc.) are functional, not representational. Any socially coherent unit of communication (a ‘text’ that plays a role within a given social practice), whether a linguistic utterance, a picture, a mime, a research paper, is not assumed to represent any objective feature of an independently existing ‘real world’ but functions to realize, that is, to ‘make real’ the following: the *field* of discourse—the event being spoken about; the *tenor*—who are the interlocutors and what are their relationships to each other and to the event; and the *mode* of discourse—the role of the text itself within the event. The way we experience the world is thus construed through the use we make of language and other means of communication (Halliday and Mathiessen 1999). This use of communication is shaped (though not determined) by the immediate context in which it takes place (the context of situation) and by the wider social practices, cultural norms and expectations with which the participants are familiar (the context of culture). Semiotic analysis that seeks to understand how meanings are formed thus needs to take these contexts into account.

While social semiotic theory and analytic approaches have been extended to encompass non-verbal semiotic systems (Jewitt et al. 2016; Kress and Van Leeuwen 2006), including specialized mathematical systems such as geometric diagrams (Alshwaikh 2011), algebraic notation and Cartesian graphs (O’Halloran 2005), verbal language still comprises the most sophisticated and differentiated semiotic resources and it is here that I focus my attention in this chapter. Within social semiotics, systemic functional linguistics (SFL) has developed descriptors that enable analysis to distinguish how specific lexicogrammatical characteristics of texts perform ideational, interpersonal and textual metafunctions, contributing to realizing the field, tenor and mode of discourse respectively. In this paper, I will focus primarily on the ideational metafunction, the way that language realizes the field of discourse. In the context of mathematics education research, analysis of how communication functions ideationally can address general questions such as the following: What is mathematics (in the context of the communication that is the current object of study)? Who or what does mathematics? What do teachers do? What do students do? (See Morgan 2006). In this chapter, the first example I

present addresses the first two questions, interrogating the nature of mathematics and mathematical activity that may be construed by students faced with two slightly different texts. The second example focuses on the last two questions, considering how a set of texts current in school mathematics contexts in England creates possible positions, actions and relationships for teachers and students.

8.2 Example 1: Analyzing the Mathematics in School Mathematics

In my first example, my focus is on how students may experience and engage in mathematics itself, illustrating the use of SFL tools to analyze how some small extracts of school mathematics text function to realize mathematical activity and considering possible implications for students. Halliday identifies the transitivity system as a significant contributor to the ideational metafunction, enabling participants in communication to construe what is happening and who and what is involved. In traditional grammar, a verb is termed transitive or intransitive, depending on whether it can take a grammatical object. Halliday's transitivity system extends this notion to encompass all types of relationships among processes (often expressed as verbs), participants (e.g. subjects and objects of processes) and circumstances (e.g. the time, manner or place in which a process occurs). SFL describes in general terms the implications of particular lexicogrammatical choices within the transitivity system. Thus, taking a mathematical example, we can say that statements (1) and (2) below construe different versions of the nature and origin of a geometric figure:

P lies on the line AB and CP is perpendicular to AB. (1)

A perpendicular dropped from C meets AB at P. (2)

Statement (1) draws our attention to the properties of the points and lines and relations between them, using the atemporal present tense and an attributive relational process (*is perpendicular*), whereas in statement (2) the past participle *dropped* suggests an action taking place in time, although agency in this action is obscured (who or what dropped the perpendicular is unknown), and the figure may be construed as having been constructed rather than simply existing (see Morgan 2016, for a fuller discussion).

Analysis is not, however, a simple matter of reading off 'the meaning' or the specific way the text functions from the lexicogrammar. The descriptions above are not enough to allow us to draw conclusions about the significance of such differences for participants in particular practices. For this purpose, it is necessary to take account of the immediate context of situation within which the texts occur as well

as the broader cultural context, including the social structures, assumptions, and values of the broader communities implicated in the practice. In this case, statement (1) formed part of a question set in a high-stakes examination taken by students in England at the end of compulsory schooling. Statement (2) is a transformed version of statement (1), incorporating grammatical forms used in a similar examination question set in another year.¹ Because of their origin in externally set, high-stakes examinations, these texts may be seen as part of an official mathematical discourse, likely to influence the forms of mathematics experienced in classrooms. The original context of situation of these texts and others like them thus included students' experience of school mathematics up to the point of examination, the physical and social environment of the examination room, the linguistic and mathematical resources brought by students to the examination, etc. The context of culture would include the following: the roles that such examinations and qualifications play in individual lives and in the broader society; public and academic views of the nature of mathematics; and, more generally, the values, norms and ways of communicating of the students' communities and of the dominant groups in national and international society.

These contexts are not homogeneous, nor will all students experience them, and hence relate to the texts, in similar ways. Given the examination setting, an important contextual consideration is the extent to which students are likely to be able to recognize and draw upon their previous mathematical experience in order to interpret such statements and the examination tasks of which they form part. The official discourse of education and examination in England and elsewhere also places value on equality of opportunity—a value that forms part of the context of culture. It is thus relevant to consider how these statements may function for different groups. For example, statement (1) has a simpler grammatical structure than statement (2) (consisting of two simple clauses joined by *and* rather than involving a complex nominal group with a dependent clause *dropped from C*); it may thus offer fewer linguistic obstacles for students with lower levels of literacy in English. On the other hand, statement (1) is also consistent with the tendency of academic mathematical discourse to be impersonal and to deal with the properties of mathematical objects and the relationships between them rather than on actions, construing “a world made out of things, rather than the world of happening—events with things taking part in them—that we were accustomed to” (Halliday 1993, p. 82). It may thus be less familiar than statement (2) for students whose everyday ways of communicating focus primarily on people and actions (see, for example,

¹The analysis reported in Example 1 was undertaken as part of the project *The Evolution of the Discourse of School Mathematics*, funded by the UK Economic and Social Research Council (grant number ES/1007911/1). This project sought to describe changes over time in the discourse of school mathematics, seen through the lens of high-stakes examination.

Lunney-Borden 2011 on the ways of speaking and knowing of indigenous people in Canada²), and hence harder to engage with in the ways expected by the examiners.

Social semiotics considers language to be a semiotic system encompassing a ‘meaning potential’, that is, the set of ways of experiencing the world that may be construed through linguistic means. The use of SFL tools not only describes the lexicogrammatical structure of a given text but also, through analyzing this structure, enables us to describe how the text functions ideationally, interpersonally and textually to offer particular forms of experience. In this case, I have identified differences in the potential of the two short statements to allow readers to construe a geometric figure either as a set of objects and relationships between them or as the result of a process of construction. For those of us who have successfully learnt to participate in specialized mathematical discourse (including teachers, textbook authors, examiners, test designers), the significance of this distinction may not be immediately apparent, since, in coming to grips with the object-process duality of many mathematical constructs, we often fail to recognize it or to appreciate how novices may experience it in a less unified way. For less experienced students, however, the differences may have a more significant effect on how they relate to the mathematical situation and respond to the examination task.

In presenting this small example, I do not seek to make claims about the nature of school mathematics in general, or even within the English examination system. Such claims would require analysis of much more substantial samples of text. Nor do I seek to claim that student readers will necessarily respond to the texts in the ways suggested—this is also an issue that requires investigation. Rather, the analysis of the two texts and discussion of how some groups of students may relate to them has potential to inform the choices made by the authors of examinations, textbooks and other school mathematics texts.

8.3 Example 2: Official “Good Practice in Mathematics Teaching”

In my second example I move away from the immediate site of interaction between student and mathematical text to consider the domain of government and its interaction with schools and teachers. I illustrate one way in which a social semiotic orientation can illuminate patterns in larger texts and sets of texts. The example I discuss is an analysis of a set of five short documents (3–4 pages each) downloaded from the website of the UK government agency, the Office for Standards in Education (Ofsted). The page from which they were downloaded was entitled

²Thanks to Beth Herbel-Eisenmann (personal communication) for focusing my attention on linguistic variation as an aspect of context.

“Ofsted examples of good practice in mathematics teaching”³ and each document presents a case study, describing the practice of a school or college.

Why are these documents of interest to me as a researcher in mathematics education? To answer this question, I have to delineate some context, which includes some key characteristics of the national education system in England and, in particular, the role that Ofsted plays in regulating schools. Every school and further education college in receipt of state funding is subject to regular inspection by Ofsted. The inspection encompasses consideration of national test and examination results as well as scrutiny of various aspects of management and observation of teaching and of student behavior. This results in allocation of grades for a number of aspects, ranging from 1 (outstanding) to 4 (inadequate). A grade of 4 in one or more aspect can result in ‘special measures’ and re-inspection. Failure to improve adequately can result in the removal of senior managers and even closure of the school. Inspection thus has very high stakes for school management. Ofsted also publishes periodic reports on various aspects of education, providing national overviews. These include descriptions of what the agency identifies as ‘good practice’, such as the documents considered here.

As with any high-stakes assessment regime, Ofsted has a strong influence on practice within many schools, not only dominating management priorities but also affecting the day-to-day practice of teaching, as the work of teachers and subject departments is subject to monitoring and regulation by school managers, using criteria shaped by their perception of what will be valued by Ofsted inspectors. This institutional environment constitutes part of the context within which the documents discussed here are located, affecting the ways that potential readers may read them.

My particular concern is with how these texts function ideationally, that is: What is the world of “good practice in mathematics teaching” that Ofsted provides for the reader to construe? As in the previous example, I attend to the transitivity system. In this case, the particular focus of my analysis is on how teachers and students feature in this world: the processes in which they are agents or which they are subjected to, their attributes and the ways they are classified. In this chapter, given the limited space available, I present only an analysis of teacher and student agency, addressing

³This webpage can be accessed at <https://www.gov.uk/government/collections/ofsted-examples-of-good-practice-in-mathematics-teaching>. The documents analyzed here were last accessed and downloaded on 14 December 2015 but the webpage is regularly updated to provide a recent set of examples. An attempt to access the documents on 8 March 2016 revealed that two of those included in the current data set had been removed. Attempts to access the two missing documents revealed messages to say they had recently been withdrawn. In one case (School L) the withdrawal was justified because it was over 3 years old. In the other case (School A) it was more strongly stated that: “This good practice example no longer reflects current government policy”. Accessing again on 10 February 2017 found only one of the original case studies (School C) together with two new cases focusing on examples of “family learning”, organised by adult education services, rather than on school practice.

the question of what teachers and students do within Ofsted’s world of “good practice”.

The analysis starts at the level of the clause, identifying in each case who or what are the actors in what kind of process. This process was supported by use of NVivo, coding each clause according to agency, identifying whether agency was ascribed to teachers, to pupils, to the school management or to an inanimate or abstract construct, or whether agency was obscured, for example by use of the passive voice. Codes were also allocated to clauses attributing qualities to teachers or to pupils but analysis of these attributes is beyond the scope of this chapter. All clauses in which agency was ascribed to teachers or to pupils were extracted in order to investigate the types of processes and circumstances involved.

In the previous example, analysis of isolated statements was used to highlight how specific linguistic choices have potential to make differences in the ways that the world of geometry may be construed. Here, however, my interest is in developing an understanding of the world of “good practice” that may be construed by readers of these official texts. In this case, it is necessary to look at patterns that recur within each text and across the full set of texts. For this, I have adopted a version of Lemke’s (1983) thematic analysis, simplified to consider only the transitivity system of actors, processes and circumstances. This form of analysis identifies common semantic structures through the cohesive devices present in the text, in order to identify semantic themes that are established by recurrence within single texts or throughout the whole corpus. A common structure may be detected not only in the direct repetition of specific actor/process relations but also in lexical covariation, such as the presence of synonyms, and in grammatical transformations of similar relationships. In what follows I denote such recurring themes by the use of capitals, e.g. PUPILS NEED SUPPORT. (Note that these texts tend to use *pupil* rather than *student*. This choice of word suggests that one should construe young people in accord with their institutional relationships rather than as people who study.) The identification of such a theme summarizes an Actor-Process-Goal structure that recurs in a variety of forms. In the set of texts considered here, for

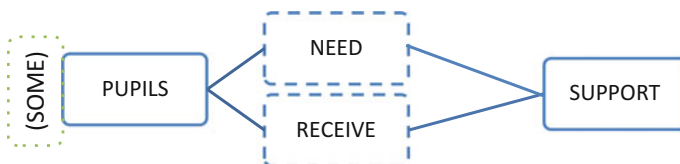


Fig. 8.1 Summary of recurrent themes relating “pupils” and “support”

example, the semantically related constructions PUPILS NEED SUPPORT and PUPILS RECEIVE SUPPORT are found in three of the five texts, both in this form (Actor-Process-Goal) and in other forms, including:

“Pupils receive the support they need”	The nominal group <i>the support they need</i> transforms the process <i>need</i> so that it qualifies the object <i>support</i> . This statement thus incorporates both PUPILS NEED SUPPORT and PUPILS RECEIVE SUPPORT
“Less able pupils benefit from expert support for their individual needs”	The process <i>benefit from</i> is considered here to be semantically related to <i>receive</i> , with the additional attribution of positive value The nominal group <i>support for their individual needs</i> is a grammatical transformation, objectifying the basic relationship PUPILS NEED SUPPORT. In this statement, the qualifiers <i>less able</i> and <i>individual</i> introduce an additional semantic component, constructing a classification of different types of pupil
“Pupils receive appropriate support”	The qualifier <i>appropriate</i> is considered to be semantically related to what pupils <i>need</i>

These recurrent semantic themes, summarized at the level of the set of texts, are shown in Fig. 8.1. The themes may be read directly from the figure:

(SOME) PUPILS NEED SUPPORT

and

(SOME) PUPILS RECEIVE SUPPORT,

noting that the qualification (SOME) does not occur in every instantiation of these themes.

In the next sections, I present the outcomes of the thematic analysis in order to describe those parts of the ideational structure of the world of “good practice in mathematics teaching” in which teachers and pupils are actors.

8.3.1 What Do Teachers Do?

The statements with teachers as agents were scrutinized in order to characterize the nature of teachers’ role within Ofsted’s construal of “good practice”. In order to develop a thematic analysis of the nature of teacher activity presented in the texts, these statements were further categorized as being about teaching (43 statements), about assessment (20 statements) or involving an activity that was not directly related to student-teacher interactions (17 statements), including mainly collaborating with colleagues and developing their practice by receiving feedback or training. In this chapter, I present the analysis of teaching activity. Figure 8.2 shows the three main types of teaching activity, present in all five case studies.

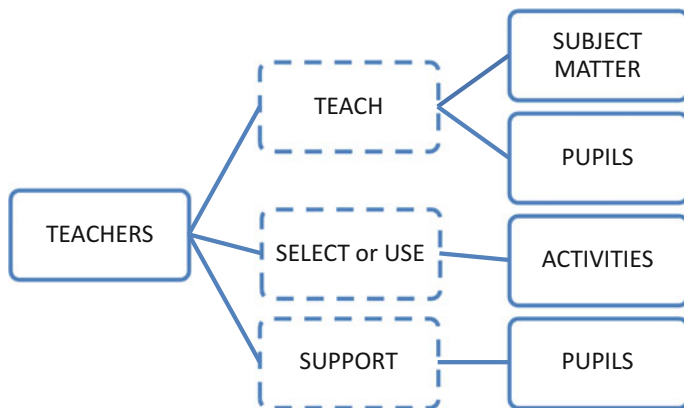


Fig. 8.2 Thematic analysis of teaching activity—dominant discourse across all schools

As might be anticipated given that PUPILS NEED and RECEIVE SUPPORT (as identified above), we find a reciprocal thematic structure TEACHERS SUPPORT PUPILS. Apart from supporting, TEACHERS TEACH both the subject matter and the pupils, though interestingly they do not appear to teach mathematics TO pupils. The teachers’ role is perhaps made clearer by the additional thematic structure TEACHERS SELECT/ USE ACTIVITIES. Having chosen appropriate activities for their pupils, further actions taken by teachers in the classroom are absent or invisible.

Just two of the school case studies provide more detailed insight into specific aspects of teaching and how they are valued (Fig. 8.3). In the case of School A, positive value is ascribed to creativity, as an attribute of both teachers and teaching, while teachers are also construed as acting directly upon learning, for example, “making learning outstanding”.

This valuing of creativity is apparent in the School A case study not only in the way that teacher activity is directly presented in the recurrent semantic theme TEACHERS USE (CREATIVE/EXCITING) STRATEGIES, but also in other ways, in particular by contrasting current practice in the school with “traditional lessons” and “textbook lessons”, and by labeling the lack of prescription in the school’s scheme of work as “surprisingly informal”. It is worth noting that a more

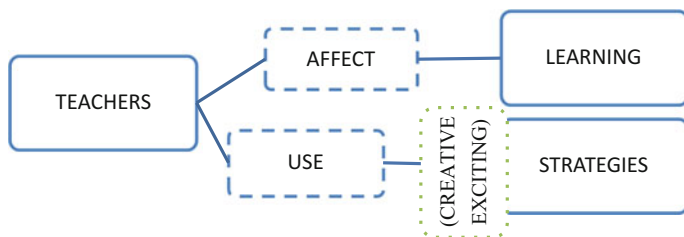


Fig. 8.3 Additional thematic structure of teaching activity in School A

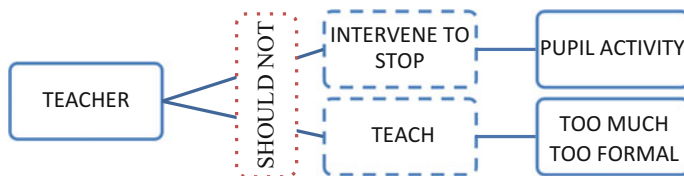


Fig. 8.4 Additional thematic structure of teaching activity at School B

recent attempt to access this slightly anomalous case study found that it had been removed from the Ofsted website with a statement that “This good practice example no longer reflects current government policy.”

The second case study that provides more details about teaching processes is School B (Fig. 8.4). In this case, the kind of teaching that is valued is presented only by contrast with processes presented as negative or inappropriate, for example:

All too often teachers risk intervening and doing the investigation for the children!

We would never stop a child who has an efficient method, but often we find that if a child has been taught a formal written method at a very early age, it may be at the expense of their grasp of mental methods.

Interestingly, these negatively valued teaching processes are not contrasted with positively valued actions of teaching but with processes that are identified (and positively valued) as forms of assessment: rather than intervening while children investigate, “[t]eachers are encouraged on these occasions to listen and record.”

8.3.2 What Do Pupils Do?

The processes in which pupils are presented as agents are rather more diverse. To some extent, this diversity is due to the way the texts ascribe attributes to pupils, distinguishing them into different groups, which are then ascribed different forms of

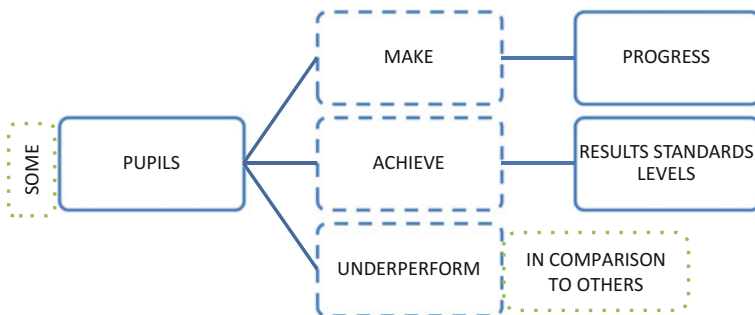


Fig. 8.5 Thematic structure of pupil achievement—dominant discourse across schools

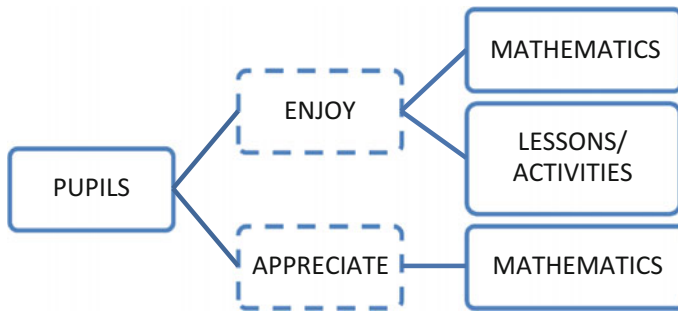


Fig. 8.6 Thematic structure of pupil affective response—dominant discourse across schools

agency. In particular, all the case study texts distinguish some pupils as being more or less “able” or as achieving more or less than their peers. A semantic grouping of statements involving pupils as actors resulted in four main categories, related to Support, Achievement, Affective response and Classroom activity. The results of thematic analysis regarding the category of Support were presented above (Fig. 8.1). The other three categories are presented below.

8.3.2.1 Achievement

Two ways of conceptualizing pupil achievement are thematized across the set of texts. On the one hand there is a dynamic process: (SOME) PUPILS MAKE PROGRESS. From this perspective, pupil achievement is recognized as taking place over time and measured relative to each individual’s starting point. On the other hand, the theme (SOME) PUPILS ACHIEVE RESULTS/STANDARDS/LEVELS measures pupil achievement at a particular point in time against a fixed standard. The third theme identified in Fig. 8.5 also compares pupil achievement to a norm but in this case identifies failure rather than achievement: (SOME) PUPILS UNDERPERFORM.

Many of the occurrences of the themes grouped under this heading are qualified by an indication that different groups of pupils achieve in different ways or to different extents. This is consistent with the persistent dominance in the English education system of assumptions, institutional structures and practices that separate children according to ‘ability’ (Morgan 2017).

8.3.2.2 Affective Response

All the case studies include statements claiming that pupils have positive affect towards mathematics or towards their mathematics lessons (Fig. 8.6). In most cases, this is simply stated as liking or enjoying mathematics, PUPILS ENJOY MATHEMATICS. In other cases, this enjoyment is attributed to lessons or, in a few

cases, specific forms of lesson activity, PUPILS ENJOY LESSONS/ACTIVITIES, e.g.:

Students enjoy a range of sorting and matching activities, often in pairs or groups that promote discussion and help to develop their understanding.

A claim linking pupils’ beliefs about mathematics to positive affect is made in two of the cases, PUPILS APPRECIATE MATHEMATICS. In particular, in School N, a post-compulsory college catering for young people aged 16-19, this theme is especially strong, focusing repeatedly on the ‘relevance’ of mathematics, rather than on pure enjoyment, for example:

They also appreciate the way that numeracy development is made relevant to their main area of study and to real life.

8.3.2.3 Classroom Activity

As found in the analysis of teacher activity, little detail is generally included about the ways that students act in classrooms (Fig. 8.7). Two main types of theme are

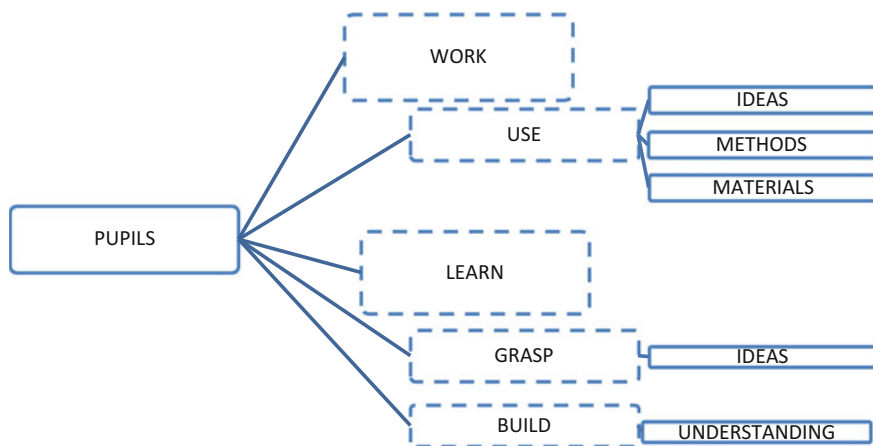


Fig. 8.7 Thematic structure of pupil classroom activity—dominant discourse across schools

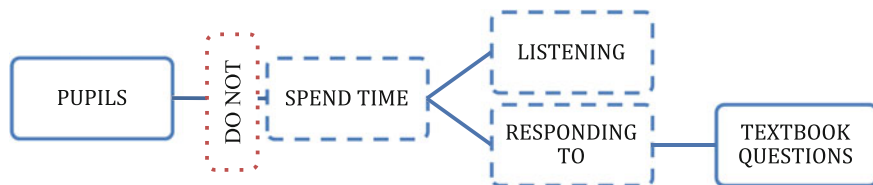


Fig. 8.8 Additional thematic structure of pupil activity in School A

identified in relation to classroom activity, each of which appears both in a generic form and in elaborated forms. On the one hand, PUPILS WORK. Where the nature of this “work” is elaborated, it involves resources that PUPILS USE ... MATERIALS or previously learnt IDEAS or METHODS. The second type of pupil classroom activity is learning: PUPILS LEARN. Interestingly, the nature of learning activity is elaborated by two, slightly different, physical metaphors: PUPILS GRASP IDEAS and PUPILS BUILD UNDERSTANDING.

Just two of the case studies offer more detailed exemplification of classroom activity: in School A an extended description is given of a simulation activity involving pupils in buying, selling and negotiating discounts, while the School B case study includes reference to one pupil “working on an exercise practicing the meaning of ‘is equal to’”. While these two examples contribute to how readers may construe pupils as actors in classrooms, they are very limited and specific, making it unlikely that a reader could form a general impression of what pupils do in classrooms in either of these schools. The only more general descriptions of what pupils do are presented in the negative in the School A case study (Fig. 8.8). As noted in the analysis of teacher activity discussed above, for School A, current pupil activity is valued by contrasting it to a supposedly ‘traditional’ practice in which pupils are passive recipients LISTENING or RESPONDING.

Other references to more specific forms of classroom activity are objectified, using nouns or nominal groups such as *investigation*, *calculation*, *problem solving*, *discussion*, *practical activity*, *structured play*, *sorting and matching activities*. This objectification obscures the roles that students and teachers may play, providing no indication of where agency might lie in relation to these types of activity.

8.3.3 Reflecting on the Thematic Analysis of Official Discourse on Teacher and Pupil Activity

The dominant discourse, present in all five texts, does not problematize or elaborate the process of teaching. The few examples of classroom activities do not provide generalizable principles for devising or evaluating further activities. As the thematic structure offers little description of what is involved in teaching a topic or teaching students, the texts present a world in which everyone is assumed to know and agree upon what constitutes ‘teaching’. Given that these texts are labeled as case studies of good practice, serving as models for development of practice in other schools, it appears that, in general, teaching is not to be seen as a site for development. This conclusion, drawn from texts published officially in 2015, is in stark contrast to the extensive guidance about “good teaching” in official documents published prior to the election of a new Conservative/Liberal coalition government in 2010 and since removed from official websites (see Morgan 2009 for an analysis of official discourse from the pre-2010 era). Rather than the development of teaching, the case

studies place emphasis on ‘support’ for pupils. The broader analysis of actors and processes also identified ‘monitoring’ as a highly valued activity (22 occurrences across the five texts) to be undertaken by teachers and by school management. It appears that the policy reflected in this set of texts (accessed in December 2015) focuses on achievement (and the need to support some pupils to reach required levels of achievement) and progress (monitored to ensure that it is adequate) rather than on the processes of teaching that might enable these.

8.4 Implications of a Social Semiotic Approach to Research

The two examples presented in this chapter have illustrated the application of a social semiotic approach at two different grain sizes. The first example took single statements as its unit of analysis, while, in the second example, the unit of analysis was a corpus of five documents, comprising a total of 18 pages. In both cases, the analysis addressed how the texts function ideationally: how they realize the world of geometric objects, or of teachers, pupils and their activities. The starting point in each case was identification of actors and processes, though these were then examined using tools appropriate to the scope of the unit of analysis. To compare the two single statements in example 1, grammatical choices at the level of the clause were identified, revealing potential differences in the way readers might construe geometric objects and activity. In contrast, the thematic analysis used in example 2 worked at the level of the whole set of documents, identifying persistent patterns of actor-process relationships in order to identify how the activity of mathematics teachers and their pupils is construed in the discourse of a government agency. A clause-level analysis similar to that used in example 1 could also be conducted across a more substantial text or set of texts in order to characterize the quantitative distribution of particular grammatical choices.

As discussed earlier, taking a social semiotic perspective to analyze communication entails more than simply applying a set of linguistic tools or techniques. In order to consider how the communication may shape the ways participants experience the world, it is also necessary to take account of the context of situation in which the texts are produced and used and the broader context of culture shared by the participants in the communication. Of course, not all participants draw on identical experiences, cultural contexts or discursive resources; alternative interpretations and ways of construing the world are possible. In presenting the examples in this chapter, I have attempted to give enough of my understanding of these contexts (as an ‘insider’ in the education system in England) to provide backing for the interpretations I have made. Responses from colleagues with whom I have shared these examples provide support for my contention that the interpretations presented here are convincing to others with knowledge and experience of the English education system.

The examples presented in this chapter illustrate some of the power of a social semiotic orientation to provide insight into those aspects of mathematics education beyond the immediate context of teaching and learning processes and interactions. Understanding mathematics education as a complex of social practices situated within social structures draws attention to a wider range of relevant practices. It also enables analysis of the meanings that may be construed through texts produced within a given practice to be informed by knowledge of the contexts within which they are likely to be read. Focusing on texts produced in the official fields of examinations and of school monitoring and accountability has enabled identification of hegemonic discourses and hence of strong messages about teachers, pupils, mathematics, teaching and learning that permeate schools in England. Knowledge gained by this analysis enables critique and provides support for resistance to these messages. While the analysis reveals how the ‘ideal reader’ addressed by the text may construe their experience of mathematics education, the ways we experience the world are not determined by the hegemonic discourse. Our critical awareness of alternative ways of speaking about mathematics, teaching and learning makes it possible to challenge the institutional assumptions embodied in such texts and to change these assumptions by imagining and speaking of other ways of thinking and being. An important method of critique is to point not only to what *is* but also to how it might *be different*. Here SFL has much to offer as it is predicated on the notion of language as a *system*, conceptualizing specific instances of texts as formed by making (not necessarily deliberate or conscious) choices between paradigmatic and syntagmatic alternatives in the lexicogrammar, and on the theoretical principle that these choices affect how texts *function* in realizing the field, tenor and mode of discourse. This empowers us to consider, for example, what difference it might make to students if geometry were presented as actions and their outcomes instead of as a set of objects and relationships. It enables us to ask what difference it could make to teachers and students if the messages of the official discourse directed the attention of school management to, say, the quality of mathematics teaching rather than (or as well as) the quantity of student achievement.

References

- Alshwaikh, J. (2011). *Geometrical diagrams as representation and communication: A functional analytic framework*. (unpublished PhD thesis), Institute of Education, University of London, London.
- Halliday, M. A. K. (1978). *Language as social semiotic: The social interpretation of language and meaning*. London: Edward Arnold.
- Halliday, M. A. K. (1993). Some grammatical problems in scientific English. In M. A. K. Halliday & J. R. Martin (Eds.), *Writing science: Literacy and discursive power* (pp. 69–85). London: Falmer.
- Halliday, M. A. K., & Mathiessen, C. M. I. M. (1999). *Construing experience through meaning: A language-based approach to cognition*. London: Continuum.
- Hodge, R., & Kress, G. (1988). *Social semiotics*. Cambridge: Polity Press.
- Jewitt, C., Bezemer, J., & O’Halloran, K. (2016). *Introducing multimodality*. London: Routledge.

- Kress, G., & Van Leeuwen, T. (2006). *Reading images: The grammar of visual design* (2nd ed.). London: Routledge.
- Lemke, J. (1983). Thematic analysis: Systems, structures and strategies. *Recherches Semiotiques/ Semiotic Inquiry*, 3, 159–187.
- Lunney-Borden, L. (2011). The ‘verbification’ of mathematics: Using the grammatical structures of Mi’kmaq to support student learning. *For the Learning of Mathematics*, 31(3), 8–13.
- Morgan, C. (2006). What does social semiotics have to offer mathematics education research? *Educational Studies in Mathematics*, 61(1/2), 219–245. <https://doi.org/10.1007/s10649-006-5477-x>.
- Morgan, C. (2009). Questioning the mathematics curriculum: A discursive approach. In L. Black, H. Mendick, & Y. Solomon (Eds.), *Mathematical relationships in education: Identities and participation* (pp. 97–106). London: Routledge.
- Morgan, C. (2014). Understanding practices in mathematics education: Structure and text. *Educational Studies in Mathematics*, 87(2), 129–143. <https://doi.org/10.1007/s10649-013-9482-6>.
- Morgan, C. (2016). Studying the role of human agency in school mathematics. *Research in Mathematics Education*, 18(2), 120–141. <https://doi.org/10.1080/14794802.2016.1176595>.
- Morgan, C. (2017). From policy to practice: Discourses of mastery and ‘ability’ in England. In A. Chronaki (Ed.), *Mathematics education and life in times of crisis: Proceedings of the 9th international conference of Mathematics Education and Society* (pp. 717–727). Volos, Greece: University of Thessaly Press.
- O’Halloran, K. L. (2005). *Mathematical discourse: Language, symbolism and visual images*. London: Continuum.
- Radford, L. (2003). Gestures, speech, and the sprouting of signs: A semiotic-cultural approach to students’ types of generalization. *Mathematical Thinking and Learning*, 5(1), 37–70.
- Valero, P. (2010). Mathematics education as a network of social practices. In V. Durand-Guerrier, S. Soury-Lavergne, & F. Arzarello (Eds.), *Proceedings of the Sixth Congress of the European Society for Research in Mathematics Education* (pp. LIV–LXXX). Lyon: Institut National de Recherche Pédagogique.