Discourse Research in Mathematics Education: A Critical Evaluation of 108 Journal Articles

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There has been increased engagement in studying discourse in the field of mathematics education. But what exactly is a discourse, and how do researchers go about analyzing discourses? This study examines 108 articles from 6 international journals in mathematics education by asking questions such as these: In which traditions and in relation to which kinds of epistemological assumptions are the articles situated? How is the concept of discourse used and defined? How are mathematical aspects of the discourse accentuated? The results of this study show that a variety of conceptualizations are used for analyzing discourses but also that many articles would benefit from strengthening those conceptualizations by explicitly defining the concept of discourse, situating the article in relation to epistemological assumptions, and relating the work to other discourse studies in mathematics education.

Key words: Discourse analysis; Epistemology; Meta-analysis; Research issues; Review of research

Conventionally, research articles are expected to deal with theoretical terms in a precise manner and to situate theoretical issues in the body of directly related research. However, as Niss (2007b) notes, "many mathematics education researchers relate their work to explicitly invoked theories *borrowed from other fields* . . . and often do so in rather eclectic or vague ways" (p. 101). Niss (2007a) observes that, in many articles, "some theoretical framework is being referred to in the beginning or at the end of the publication without having any presence in between" (p. 1309). That is, theories are often presented in the beginning of the research report, but are used neither to analyze data nor to discuss the results of the study. Moreover, terms adopted from other work are seldom defined and often not used consistently. Sfard (2008) stresses the importance of conceptual accountability, "being explicit about how we use the keywords and how our uses relate to those of other interlocutors" (p. 42). Some key words or phrases are particularly complex and multifaceted, making articulation of their meaning essential. In reference to the complex construct of problem solving, Schoenfeld (1992) points out the need "that every study or discussion of problem solving be accompanied by an operational definition of the term and examples of what the author means" (p. 364).

Recently, the complex and multifaceted construct of *discourse*,[1] and related traditions of discourse analysis, have been used in a growing body of research in mathematics education. The interest in discourse and discourse research in

mathematics education may arise from at least three different sources. First, mathematical classroom communication and the development of discourse communities in classrooms are stressed in reform documents (e.g., NCTM, 2000). Second, discourse research in other scientific disciplines has developed theoretical perspectives and analytical constructs to conceptualize and analyze phenomena of relevance in mathematics education, such as *interaction*, *agency*, *identity*, *positioning*, and *gender*. Third, scholars have conceptualized mathematics as a discourse (e.g., Moschkovich, 2002; Sfard, 2008).

In light of the amount of research in mathematics education focused on discourse, coupled with Niss's (2007a, 2007b) and Sfard's (2008) calls for being explicit in research reports about essential concepts and their use, it is of interest to take a closer look at how the concept of discourse and discourse traditions are invoked and used in research studies in mathematics education. This inquiry is guided by three research questions that cover important aspects of how the concept of discourse and discourse traditions are used in mathematics education research:

1. How are articles in prominent mathematics education journals focused on the concept of discourse theoretically conceptualized?
2. What data are used in these articles, and how are those data analyzed?
3. In what ways and to what extent do these articles build on each other?

Question 1 focuses on ways of defining and using the construct of discourse as well as on epistemological perspectives and how they are used to conceptualize the object of study in the articles. Ways of defining and using key constructs as well as situating studies in epistemological perspectives have been recognized by several scholars as important aspects of high-quality articles in mathematics education (e.g., Cobb, 2007; Dörfler, 1993; Niss, 2007a; Sfard, 2008). Question 2 covers aspects of data use as well as how the articles stress and analyze mathematically relevant features. Many scholars (e.g., Kilpatrick, 1993, 1995; Lester & Lambdin, 1998; Silver & Herbst, 2007) emphasize explicitness of mathematics within studies in mathematics education as a key criterion for high-quality articles. Further, ways of transcribing oral data are seen as an integrated and important aspect of data analysis (e.g., Ochs, 2005) and therefore relevant for many mathematics education studies. Question 3 is related to the importance of building seriously on other relevant publications. Due to the selection of articles within this study, this research question captures aspects of how articles in the corpus of studies examined build on each other theoretically.

Responses to the three research questions are constructed by drawing on overviews of discourse research (e.g., Jaworksi & Coupland, 2005a; Wetherell, Taylor, & Yates, 2001a) and elaborations of key issues connected to conceptualizations of mathematics as a discourse (e.g., Duval, 2006; Moschkovich, 2002; Sfard, 2008), and by categorizing essential features of 108 journal articles.[2] In relation to the

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[1]The word *discourse* and its different uses will be addressed subsequently.

goal of the research and the research questions, this article is not a review of emerging themes in discourse research in mathematics education but rather a critical evaluation of how the concept of discourse and discourse traditions are used in mathematics education research.

DISCOURSE RESEARCH AND MATHEMATICAL DISCOURSES

It is not possible to produce a simple description of the many ways in which the concept of discourse is used (van Dijk, 1997) and certainly not possible in this article to sketch an exhaustive picture of all strands of analytical approaches to discourse. Instead, underlying principles, definitions, topic areas, traditions, and scientific disciplines in discourse research that are of relevance for examining discourse research in mathematics education will be guided by several sources, most notably the overview of discourse research by Wetherell, et al. (2001a).[3]

Principles

The study of discourse is the study of human communication; the most unique of this communication is language[4] in use. A focus on language use could be seen as a reaction against the dominant structuralist tradition within linguistics and the humanities that treats and analyzes language as a system (Kress, 2001). This focus on language use is tightly connected to the idea that language use should be seen as a social action, and Wetherell (2001b) highlights three important principles or assumptions for such a perspective. The principles are used both to ground this article and to guide the use of analytical questions to gather and organize information about the corpus of articles on which this study is based. These analytical questions—also discussed in the Method section—are:

1. Is the concept of discourse defined?
2. How is the concept of discourse used?
3. What is the object of study in the article?
4. Which kinds of epistemological principles and traditions are used in the article?
5. What data are analyzed?

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[2]See the appendix for full references of all articles. References for the 108 articles cited appear only in the appendix.

[3]There are many overviews of discourse research such as Jaworksi and Coupland, (2005a), Phillips and Jørgensen (2002), Schiffrin (1994), and van Dijk (1997). Whereas Wetherell et al. (2001a) is slightly more focused on discourse studies in the social sciences, Schiffrin (1994) puts more emphasis on linguistics and van Dijk (1997) on critical discourse research. The reason for primarily using the structure of Wetherell et al. is that I found it helpful to formulate, legitimate, and make categorizations in relation to the analytical questions (presented in the Method section) that are used to operationalize the three research questions. An underlying assumption here is that a measure from outside mathematics education—such as Wetherell et al.—can be used productively to examine articles within mathematics education.

[4]*Language* is here defined as a system, used for communication, consisting of a set of symbols with connected rules by which the manipulations of these symbols are regulated (cf. Sfard, 2008).

6. How was spoken data transcribed?

7. How are mathematical aspects of the discourse accounted for?

8. In what ways and to what extent does the article refer to other articles?

The first of Wetherell's (2001b) principles notes that language use is seen as constitutive and constructive: it builds objects, minds, identities, and realities. This approach is strongly influenced by the later works of Wittgenstein and from this epistemological position: "[L]anguage ceases to be a neutral medium for the transmission and reception of pre-existing knowledge. It is the key ingredient in the very constitution of knowledge" (Jaworski & Coupland, 2005b, p. 3). The discursive view of language use implies, among many other things, a shift in research focus. Instead of trying to examine how language use corresponds to reality, language use as such becomes the object of study. The second principle emphasizes not only that discourses construct versions of reality (first principle) but also that the versions of reality they construct are designed to accomplish objectives such as undermining arguments, convincing, or portraying description as neutral (Potter, 1996). Discourses are therefore functional, and for the discourse researcher, it becomes interesting to ask questions such as: Why construct this version of the phenomenon? What does this version accomplish in this setting? What does it tell us about wider sociocultural contexts[5] that constrain and enable certain actions to be performed and versions of reality to be told?

The third principle asserts that meaning is co-constructed. Co-construction should be understood both from a macro perspective and from a micro perspective. The macro perspective refers to the idea that meanings of words and ways of talking are developed through social and historical processes, whereas the micro perspective emphasizes the fact that the meanings of language use must be understood in relation to the immediate surrounding interaction. Some traditions of discourse research, such as conversation analysis and sociolinguistics, focus on co-construction on a micro level; and other traditions of discourse, such as Foucauldian research and parts of ethnography of speaking, are mostly engaged in broader co-constructions.

Concept of discourse *and Topic Areas*

Gee (1996) distinguishes between *discourse* and *Discourse*; the former is seen as "connected stretches of language that make sense" (p. 127), whereas the latter refers to ways of using language, or more precisely:

> A Discourse is a socially accepted association among ways of using language, other symbolic expressions, and 'artifacts', of thinking, feeling, believing, valuing, and acting that can be used to identify oneself as a member of a socially meaningful group or 'social network', or to signal (that one is playing) a socially meaningful 'role'. (p. 131)

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[5]*Interpretative repertoires* (Wetherell & Potter, 1992) or *Discourses* (Gee, 1996) are examples of constructs introduced to account for such wider sociocultural contexts. Note also that the word *discourse* is used to refer to (construct) such wider contexts or ways of talking in some traditions of discourse research, such as Foucauldian research.

Three points are important to clarify. First, Gee (1996) uses the word *language* to refer to both the structure of language and functional aspects of language use. In relation to the former use, the expression *stretches of language* makes little sense, so I interpret the expression as referring to functional aspects of language use, hence, interactions (cf. second principle). Second, Discourse as defined above does not stress only ways of using language but also how Discourses create social positions and power relations (cf. Foucault's work). Third, in the rest of the article I use the word *discourse* many times. When I use the word *discourse* to refer to the concept of *interaction*, I make an explicit reference to Gee (1996), otherwise I use the word to refer to both the concepts of *discourse* and *Discourse* (Gee, 1996) as well as other ways (cf. the third analytical question).

The three discourse principles and Gee's (1996) distinctions could be seen as a first step in developing a framework for analyzing the 108 articles. What follows is further development of the framework by distinguishing among three topic areas of discourse research: Social Interaction; Minds, Selves, and Sense Making; and Cultural and Social Relations (cf. Wetherell et al., 2001b).

Researchers interested in the first topic area, discourse as social interaction (cf. Gee's first way of using *discourse*) typically study local interactional orders of face-to-face interactions by asking questions such as: How do agents co-coordinate their talk? How are intersubjectivity and norms constructed? Researchers within this topic area often use talk as data and typically work with rather detailed transcripts, including pauses, intonation, in-breath, speed of talk, and so on (Ochs, 2005). The most influential traditions working with such questions are ethnomethodology (e.g., the work of Harold Garfinkel) and conversation analysis (e.g., the work of Harvey Sacks, 1992, and Emanuel A. Schegloff, 2007), developed within the discipline of sociology, and interactional sociolinguistics (e.g., the work of John J. Gumperz, 1982, and Michael A. K. Halliday, 1978), developed within the discipline of linguistics. Within mathematics education, the sociological strand of this topic area has been influential through the work of, for instance, Cobb and colleagues while interactional sociolinguistics and the work of Halliday have been introduced and used by, for instance, Morgan (2006).

Research conducted within the second topic area of minds, selves, and sense making focuses on how discourses influence and determine identities and agents' sense making, hence the production of social actors (Wetherell, 2001b). The broad category of discursive psychology is influential in this topic area (see, e.g., the work of Derek Edwards and Jonathan Potter, 1992) and could be seen as a reaction against cognitive psychology. Whereas Edwards and Potter approach the production of social actors within interactional situations by drawing on conversation analysis, other researchers draw on, for instance, the later work of Foucault (cf. Hall, 2001; Rose, 1996) to approach the same topic area. Therefore, it is the phenomena (e.g., production of identities, ethnicity, and gender) being studied that relate traditions within this topic area to each other rather than analytical approaches used or ways of defining the concept of discourse. This implies, for instance, that some researchers within this topic area use the word *discourse* to refer to the concept of

discourse (Gee, 1996), whereas others use it to refer to something similar to Discourse (Gee, 1996). In the field of mathematics education, for instance, Barwell (2003a) and Evans, Morgan, and Tsatsaroni (2006) are engaged in this topic area.

The third topic area, cultural and social relations, focuses on macro processes of social and institutional actions (cf. Discourse). Researchers within this topic area often draw on, or at least relate to, the work of Foucault (e.g., Foucault, 1977). The work of Bakhtin (1981), critical linguistics, and large parts of the ethnography of speaking also fit within this category.[6] Foucault was, among other things, interested in the production of power, knowledge, and meaning; and, even though he analyzed particular texts, he was much more inclined to study the larger discursive formations (e.g., Hall, 2001) to which the text could be constructed to belong. Researchers from this topic area typically ascribe the individual little agency, and Hall (2001) argues that from a Foucaldian perspective "it is discourse,[7] not the subjects who speak it, which produces knowledge" (p. 79). This claim is interesting and is closely related to discussions of what thinking is and where it is located (in the head and/or outside)—a highly topical debate in mathematics education. To conclude, the distinction between discourse and Discourse, discursive principles, and the different topic areas are used collectively as a frame for categorizing the articles and answering the first four analytical questions presented in the following section.

Traditions and Disciplines

Several traditions from a number of disciplines are used in discourse research and are used in responding to the fourth analytical question, Which kinds of epistemological principles and traditions are used in the article?

Wetherell (2001a) notes that distinctive styles of conducting discourse research have emerged and that those traditions "typically include some epistemological claim, a set of concepts and procedures for substantive work and a clearly marked out theoretical domain" (p. 382). Several traditions engaged in discourse research, introduced previously in this article, were presented by Wetherell (2001b), including conversational analysis and ethnomethodology, Foucauldian research, critical discourse analysis and critical linguistics, discursive psychology, Bakhtinian research, interactional sociolinguistics, and the ethnography of speaking. Some of these traditions are closely associated with a single topic area, whereas others are used in several topic areas. Further, some of these traditions belong primarily to certain scientific disciplines such as psychology (discursive psychology), sociology (conversational analysis and ethnomethodology), anthropology (ethnography of speaking), or linguistics (critical linguistics and interactional sociolinguistics), whereas other traditions such as Bakhtinian research, Foucauldian research, and

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[6]Some parts of the ethnography of speaking such as Moerman (1988) draw heavily on conversation analysis and therefore fit better in the first topic area.

[7]Notice here that the word *discourse* refers to something more similar to *Discourse* than *discourse* as those terms are used by Gee (1996).

critical discourse analysis (cf. van Dijk, 1993) are more difficult to categorize in terms of scientific discipline.

Summing up discourse [8] Research

Table 1 is a coarse overview of discursive research. In this table, *Talk/written text* indicates that talk as data is more common than written text, whereas the opposite holds for *Written text/talk*. It is a very simplified picture, but useful for the purposes of this article.

Table 1
Coarse Overview of Discourse Research

Topic areas	Social interaction	Mind, selves, sense-making	Cultural relations
Traditions	Conversation analysis, ethnomethodology, interactional sociolinguistics	Discursive psychology, late Foucault	Bakhtin, Foucault, critical linguistics
Data	Talk	Talk/written text	Written text/talk
D/discourse	discourse	D/discourse	Discourse
Disciplines	Linguistics, sociology	Psychology	Several disciplines

Mathematical discourses, Mathematics in discourses, and Generic Educational discourses

Because the word *discourse* is complex and multifaceted, the phrase *mathematical discourse* is also complex and used in many different ways. Mathematical discourses are different from other discourses in relation to the words, visual mediators, narratives, and routines (Sfard, 2008) that are used. Some researchers (e.g., Duval, 2006; Radford, Bardini, & Sabena, 2007; Sfard, 2008) stress that mathematical activities are heavily dependent on the use of different semiotic systems such as mathematical words, algebraic symbols, graphs, and drawings. Recently, body language and gestures have been stressed in mathematics education research (e.g., Radford, 2009). However, the exact relation between systems of signs and mathematical objects is conceptualized differently by different scholars. Duval (2006) stresses that systems of signs are *representations* of mathematical objects and that there is no way to access objects of mathematics perceptually. This

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[8]Lower case *d* in *discourse* is used to refer both to discourse and Discourse (Gee, 1996), as explained previously.

epistemological aspect of mathematics distinguishes it from other school subjects such as physics, biology, and history and has substantial implications for the teaching and learning of mathematics. Sfard (e.g., 2001, 2008), on the other hand, taking a radical nondualistic approach (cf. the first discourse principle), conceptualizes mathematical objects as discursive objects. Hence, the systems of signs and their organization into realization trees are the mathematical objects. From such a perspective, mathematical objects are accessible by perceptual means and not any less material than a concrete, tangible thing. Epistemological assumptions are highly consequential for conceptualizations of mathematics and of learning and I return to this issue later in the article.

A mathematical classroom discourse is constituted by mathematical discourses but also by more generic discourses denoted, for instance, *nonmathematical Discourses* (Moschkovich, 2002; Setati, 2005), *social norms* (Yackel, Cobb, & Wood, 1991), and *everyday discourse* (Evans et al., 2006). For instance, a statement such as "girls are less intelligent than boys," that is not part of a mathematical discourse can profoundly influence the epistemological issues of what it means to know mathematics and who could become a knower in mathematics (Burton, 1995; Walshaw, 2001). That is, certain nonmathematical discourses may shape identity positions and, therefore, possibilities for individuals to participate in mathematics discourses (e.g., Boaler, 2002; Cobb & Hodge, 2002). From such a perspective, it becomes very difficult to argue that all nonmathematical discourses are irrelevant for understanding the teaching and learning of mathematics, and a substantial number of articles in this study analyze such nonmathematical discourses. I choose to denote nonmathematical discourses that are relevant for mathematical discourses *generic educational discourses*. Generic educational discourses are therefore relevant for mathematical discourses but not part of them.

In answering the sixth analytical question, How are mathematical aspects of the discourse accounted for? (see also the Method section), I distinguish between articles focused on mathematical discourses and articles that analyze generic educational discourses. The first category includes both articles that conceptualize mathematics as a discourse and articles that stress mathematical features in analyzing classroom discourse. From an epistemological point of view, there are huge differences between articles that conceptualize mathematics as a discourse and articles that analyze mathematical aspects as they are expressed in discourse. However, for the purpose of distinguishing articles that stress mathematics or generic aspects, it is useful to merge these two epistemological perspectives into the same category. In categorizing articles as focused on mathematics, I include elaborations and/or analysis in areas such as the following:

- Mathematical sign systems, words, and visual mediators (e.g., decimal system, algebraic notation, graphs, tables) as well as epistemological and theoretical discussions of mathematics as a discourse;
- Content areas/topics/domains and subsets of them (e.g., number theory, prime factors, slope, measurement);

- Habits of mind of mathematicians (Cuoco, Goldenberg, & Mark, 1996) and ways of working mathematically (cf. Schoenfeld, 1992) (e.g., proportional reasoning, generalizing, searching for invariants, proving);
- Mathematical competencies (Niss & Jensen, 2002) and proficiencies (National Research Council, 2001) and subsets of those (e.g., conceptual understanding, strategic competence, posing problems, reasoning and argumentation); and
- Constructs derived to account for learning and knowledge in mathematics (e.g., procepts, reification, concept image, example space, sociomathematical norms).

In categorizing articles as focused on generic educational discourses, I identified articles stressing and analyzing features such as identity, gender, ethnicity, management of classroom discourse, diversity, equity, positioning, agency, use of personal pronouns, univocal and dialogical discourse, pattern of repetition, marking devices in talk, and so on.

Summing up

The ideas and distinctions in discourse research as well as views on mathematics discourses developed in this section include epistemological principles, definitions of discourse, topic areas, traditions, types of data, and disciplines from discourse research as well as distinctions between mathematics discourse and generic educational discourse. In the next section, I describe the methodology of this study and use the ideas and distinctions from the theoretical section to support an analysis of specific aspects of the 108 articles.

METHOD

Process of Selecting the Articles

I have chosen to focus this study on articles published in the following journals: *Journal for Research in Mathematics Education* (*JRME*), *Educational Studies in Mathematics* (*ESM*), *The Journal of Mathematical Behavior* (*JMB*), *Mathematical Thinking and Learning* (*MTL*), *Mathematics Educational Research Journal* (*MERJ*), and *Zentralblatt für Didaktik der Mathematik* (*ZDM*). These journals were selected for three reasons: They are established peer-reviewed journals in mathematics education; together they constitute a geographical spread of editorial influence; and they are relatively generous in terms of space restrictions compared to, for instance, the proceedings of meetings of the International Group for the Psychology of Mathematics Education.

In searching for articles focused on discourse, I decided to include articles that use the words *discourse*, *discourses,* or *discursive* in the title, abstract, or keywords. The rationale for this strategy was to include articles in which the concept of discourse was central. To find those articles, I used the databases MATHDI (now titled MathEduc) and ERIC as well as the individual journals' Web-search functions. My search included all volumes of the journals published in 2009 or earlier.

Table 2
Distribution of Articles by Journal

Journal	Number of articles
Educational Studies in Mathematics (Volumes 1–72)	41
Journal for Research in Mathematics Education (Volumes 1–40)	22
Mathematical Thinking and Learning (Volumes 1–11)	14
The Journal of Mathematical Behavior (Volumes 1–28)	13
Zentralblatt für Didaktik der Mathematik (ZDM) (Volumes 1–41)	11
Mathematics Education Research Journal (Volumes 1–21)	7

Table 3
Distribution of Articles by Years

Year	1968–1989	1990–1994	1995–1999	2000–2004	2005–2009
Number of articles	3	4	17	42	42

In total, I found and read 120 articles, of which 108 were analyzed. The remaining 12 articles were not analyzed due to reasons such as the word *discourse* was used in the abstract to refer to other studies, the article presented a literature review of studies of motivation, the article reviewed a book, and the word *discourse* or *discursive* was used only in the abstract and not in the article itself. Table 2 presents the distribution by journal of the 108 articles.

This overview makes it clear that the majority of articles (63 of 108) were published in the two most influential journals (*JRME* and *ESM*) (cf. Kilpatrick, 1995; Sträßer, 2005) in the field of mathematics education. As shown in Table 3, the distribution of articles by the year in which they were published suggests that, over time, there has been an increasing interest in discourse research in mathematics education.

Analytical Questions and Guidelines for Categorizing

In this article, it is assumed that research could productively be conceptualized as a discourse[9] (Sfard, 2008) constituted by research articles in mathematics education focused on discourse. From the three epistemological principles (discourse as (a) constitutive, (b) functional, and (c) co-constructed) there are a number of possible approaches to studying these articles. My interest here is mostly in theoretical and methodological issues related to the quality of the research articles rather

than on, for instance, the results of the articles or in more general debates about ways discourse traditions are useful in the discipline of mathematics education (see, e.g., Kieran, Forman, & Sfard, 2001), even though several reasons for the interest in discourse research were presented in the beginning of the article. By building on the overview of discourse research and mathematical discourses presented earlier, the eight previously mentioned (and re-presented here) analytical questions were formulated to operationalize this focus. The rationale for each analytical question and ways of using these questions to analyze the articles are presented subsequently.

1. Is the concept of discourse defined?
2. How is the concept of discourse used?
3. What is the object of study in the article?
4. Which kinds of epistemological principles and traditions are used in the article?
5. What data are analyzed?
6. How were spoken data transcribed?
7. How are mathematical aspects of the discourse accounted for?
8. In what ways and to what extent does the article refer to other articles?

Analytical questions 1–4 correspond to the first research question, How are the articles in prominent mathematics education journals focused on the concept of discourse theoretically conceptualized? Analytical questions 5–7 correspond to the second research question, What data are used in these articles, and how are those data analyzed? Analytical question 8 corresponds to the third research question, In what ways and to what extent do these articles build on each other?

Overviews of discourse research indicate that there are several meanings for the word *discourse* (e.g., van Dijk, 1997; Wetherell et al., 2001a). In addition, explicitness about how central concepts are used in research studies is an essential aspect of high-quality articles (e.g., Dörfler, 1993; Sfard, 2008; Sierpinska, 1993). The first analytical question, Is the concept of discourse defined?, with response categories of *Yes* and *No*, addresses this issue. To answer this question, wordings such as *discourse means*, *discourse is here used*, and *discourse is defined* were used as indicators of explicit definition of the concept of discourse. Articles without explicitly stated definitions but containing explicit discussions of the concept of discourse were also categorized as Yes.

Because the concept of discourse could be used to refer to different things with different research foci, it is of interest to characterize and quantify how the concept of discourse is used in these mathematics education articles. Each article was interpreted to belong to one of the three categories: *discourse*, *Discourse*, or

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[9]Sfard (2008) defines *discourse* as a special type of communication. As Sfard notes, Gee's (1996) use of Discourse, with its special meaning, "is not far from the one word *discourse* has within the commognitive framework" (p. 282). However, it is beyond the scope of this article to discuss further the relation between Sfard's (2008) and Gee's (1996) uses.

Speech. Gee's (1996) distinction between discourse and Discourse was used as an initial frame, but during the process of analyzing the articles it became clear that the third category of Speech was needed. In categorizing the articles, I did not rely only on explicit definitions but also on the ways that data analysis was carried out in the articles. For instance, an article focusing on verbal actions using analytical concepts from conversation analysis such as *adjacency pairs*, *minimal response*, and *three-part list* to analyze what the author calls *discourse* would be placed in the discourse/interaction category. On the other hand, an article referring to the work of Foucault noticing that discourse regulates ways of talking and acting was placed in the category of Discourse. Notice that in neither of the two examples have the authors defined the concept of discourse; rather, they have indicated, in a broad sense, how they use the concept. In addition, articles using the concept of discourse to refer to, for instance, talk in the classroom without relating this use to any of the three discourse principles (discourse as constitutive, functional, and co-constructed) or introducing constructs to account for interactional features of discourse were placed in the Speech category.

Based on the principles of discourse research, it is the language use itself that is the central object of study in discourse research (e.g., Jaworski & Coupland, 2005b). Along another dimension, some articles may be categorized as empirical and others as theoretical. In response to the third analytical question, What is the object of study in the article?, the objects of study for articles were categorized as *discourse as Such*, *Other Phenomena,* and *Theoretical*. In determining the category for each topic, I examined whether the analysis of discourse was a means to capture other objects or an integrated part of the object of study. I particularly analyzed the aim, research questions, and the results and/or conclusion of each article in connection to how the concepts within those sections were used and related to each other. For instance, if an article aims at examining "students' development of strategic competencies" and defines development as inherently interconnected to Discourse, the article is regarded as belonging in the *discourse as Such* category.

As presented in the overview of discourse research, several traditions related to different disciplines and epistemological perspectives constitute the field of discourse research (Wetherell, 2001a). Determining the traditions and epistemological principles used in the articles further illuminates the theoretical conceptualization of the articles. Response to the fourth analytical question, Which kinds of epistemological principles and traditions are used in the article?, is connected to the observation that there are several different epistemological positions taken within discourse research. Epistemological principles and conditions for articles were categorized as *discourse as Constitutive*, *discourse as a Reflection*, or *Not Explicitly Situated.* The answer to this analytical question typically appeared in the theoretical section of the articles. I particularly focused on the ways in which the relation between language use and "reality" was discussed/defined (cf. first epistemological principle). If the articles portrayed discourse and language use as, at least partly, constituting knowledge about other objects, they were placed in

the discourse as Constitutive category. In addition, I searched for explicit references to traditions used to conceptualize the articles. Examples of traditions found in the data are critical epistemology, sociolinguistics, poststructuralism, postmodern theory, sociocultural theory, theory of discourse, cultural psychology, activity theory, cognitive linguistics, discursive psychology, and ethnomethodology.

Yet another possibility for categorizing discourse articles is by the kinds of data used. As indicated in the discourse research review, different traditions typically use different kinds of data. The fifth analytical question, What data are analyzed?, addresses this issue. Data used in articles were categorized as *Talk, Written Texts,* and *Others.* Talk includes data such as interviews or classroom talk, whereas curricula, textbooks, and research articles are examples of Written Texts. The category Others refers to articles that are theoretical and present very little or no data.

As will be shown in the present article, a large majority of articles use talk as data when analyzing discourse. Traditions typically focusing on the interactive aspects of talk, such as conversation analysis, ethnomethodology, and discursive psychology, engage in discussion about how to transcribe verbal talk (see, e.g., Ochs, 2005). Further, for Jaworski and Coupland (2005a) it seems self-evident that "in every instance of empirically grounded work on discourse, researchers have to make decisions about how best to transcribe their data to suit their own priorities" (p. 129). By asking the sixth analytical question, How were spoken data transcribed?, the analysis aims to account for the engagement of such discussions in discourse research in mathematics education. Two categories of transcription were used: *Ordinary Text* and *Specific Codes*. Examples of notation for which I was looking in the transcripts include pause (2.1), overlaps [], >faster talk<, and stress. If such notations were found, I placed the article in the Specific Codes category; otherwise, I placed the article in the Ordinary Text category.

Mathematics should (e.g., Kilpatrick, 1993, 1995; Lester & Lambdin, 1998) and could be stressed in different ways in discourse research in mathematics education. I included the two categories of *Mathematics discourse* and *Generic Educational discourse* in analyzing the articles in relation to the analytical question, How are mathematical aspects of the discourse accounted for? Ways of distinguishing these categories were discussed in the Mathematical discourses, Mathematics in discourses, and Generic Educational discourses sections.

Finally, the rationale for examining to what extent and in which ways the articles build on the work of each other emerges both from the third epistemological principle of co-construction and from the analysis of the articles. The analysis of the extent to which articles refer to each other is a relatively straightforward process, which is described in the Results section. In classifying how articles referred to each other, I used two categories: *Used to Analyze Data, Develop Theoretical Ideas, or Comment on Conclusions* and *Others*. For each article, I located the relevant citation and analyzed the role of that reference in the article. For example, if the reference was found in the Introduction section of an article

and was used to mention that the article also had been focused on analyzing classroom discourse, it was categorized in Others. A typical, but hypothetical, example for the latter category would be, "Several studies have been focused on the development of classroom discourse (e.g., Cobb et al., 1997)." On the other hand, if the citation was used, for instance, for developing a theoretical frame or deepening the discussions of the conclusions, I interpreted it as belonging to the Used to Analyze Data, Develop Theoretical Ideas or Commenting on Conclusions category. More generally, the argument here is not that the only relevant articles for discourse studies in mathematics education could be found among the 108 articles but rather that it is likely that articles published in key journals in mathematics education using the word discourse in the title, abstract, and/or keywords are of relevance for later published discourse articles in mathematics education.

There are a number of additional issues that need to be clarified in relation to the analytical questions introduced above. First, each article was studied as a whole. That is, key sentences in relation to my eight analytical questions were analyzed in terms of how these sentences were used as such as well as the connection of these sentences to the article as a whole. Second, the process of categorizing the articles is not a straightforward endeavor, and a number of precautions were taken to increase the reliability of the process: analyzing samples of the empirical material together with discourse experts in seminars, having four scholars analyze 10 randomly selected articles from the empirical material to compare and discuss ways of categorizing,[10] and introducing many examples in the Results section to make explicit the choices of categorizations. In addition, complete references of all 108 articles used in this study are included in the appendix, which facilitates the possibility of reanalyzing the articles. Finally, I categorized aspects of articles and not aspects of researchers. That is, an article categorized as lacking an epistemological discussion does not imply an epistemologically unconscious researcher.

RESULTS

Research Question 1: How Are Articles in Prominent Mathematics Education Journals Focused on the Concept of discourse Theoretically Conceptualized?

The results connected to the first four analytical questions together with the overview of discourse research was used as a source for answering the first research question: How are the articles theoretically conceptualized?

Focusing on the first analytical question, Is the concept of discourse defined?,

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[10]They were given the same analytical questions, explanations of those, and categories as presented above. There were few discrepancies between the others' and my categorizations. Measuring the inter-rater reliability by means of percent-agreement figures (Stemler, 2004) yields 100% for six articles and 88.5% for four articles. Each discrepancy was carefully discussed until consensus was achieved.

the analysis shows that 19% (20 of 108) of the articles are explicit about how they define the concept of discourse, whereas 81% (88 of 108) are not. As indicated in Wetherell et al. (2001a), van Dijk (1997), and the overview of discourse research, the concept of discourse could be used in different ways for a number of purposes, suggesting that the lack of definitions might be seen as troublesome. Further, Sfard's (2008) emphasis on conceptual accountability and the guidelines for research in mathematics education (e.g., Kilpatrick, 1993, 1995; Lester & Lambdin, 1998; Sierpinska, 1993) support this claim. The argument is not that it is possible to reach an agreement about how the concept of discourse is defined, especially due to its many uses in the field (cf. Wetherell et al., 2001a), but instead, that in order to understand and build on the work of others, it is crucial to specify how discourse is defined and used in each particular study.

The second analytical question concerns how discourse is used (see Table 4). Within the first category there are articles using discourse in harmony with Gee (1996) and typically belonging to the first topic area, Social Interaction (Wetherell, 2001b). In the following paragraph, a few examples are introduced to clarify the category of discourse and its relation to the categories of Discourse and Speech.

Table 4
Ways of Using the Concept of Discourse

Way in which the concept of discourse is used	Percent of aticles
discourse (Gee, 1996)	23% (25 of 108)
Discourse	21% (23 of 108)
Speech	56% (60 of 108)

The article by Ryve (2006) falls under the first category, because it refers to Linell (1998) in defining discourse as "a stretch of concrete, situated and connected verbal, esp. spoken, actions" (Linell, 1998, p. 6). In contrast to Ryve (2006), Evans et al. (2006) define and use the concept of discourse as "a system of signs that organises and regulates specific social and institutional practices" (p. 210). This way of defining and using the concept of discourse fits the Discourse category (Gee, 1996). By using discourse to refer to a system of signs, Evans et al. view discourse as a resource or repertoire "for participants to construct meanings and identities, experience emotions, and account for actions" (p. 210). Hence, Evans and colleagues are interested in psychological aspects (cf. second topic area, Minds, Selves, and Sense Making) as constituted in Discourse. Expressed simply, Evans et al. (2006) and Ryve (2006) are using the same term but refer to different things. As discussed previously, different use is not a problem in itself but becomes problematic if such divergences are hidden for the interlocutors, which leads us to the third category, Speech. The Speech category (used in 56% of the articles, as indicated in Table 4) includes

articles that use discourse to refer to speech or talk in an atheoretical way. As previously discussed, *atheoretical* in this context refers to articles that do not implicitly or explicitly relate the use of discourse to any of the three discourse principles or introduce constructs to account for interactional features of classroom discourse.

After examining how discourse is defined and used, we turn to the question, What is the object of study? As noted in the overview of discourse research, Wetherell (2001b) as well as Antaki et al. (2003) argue that in discourse research, discourse must be the object of study and not just serve as a means to capture other external objects.

Table 5 shows that most of the studies examine discourse as Such (54%). Burton and Morgan (2000) serves as an example of an article belonging to this category, because analysis of the aim and conclusions indicate that it is discourse that is the object of study: "We examine the professional discourse of mathematicians" (p. 432).

Table 5
Main Object of the Study in the Articles

Object of study	Percent of articles
discourse as Such	54% (58 of 108)
Account for Other Phenomena	25% (27 of 108)
Theoretical Focus	21% (23 of 108)

Articles that analyze discourse to capture aspects outside, behind, or beyond discourse constitute 25% of those examined. White (2003) serves as an example of an article that analyzes "classroom discourse and its *influence* on students' mathematical thinking" (p. 37, italics added). Hence, discourses are examined with the aim of understanding how they influence the object of students' thinking.

Finally, 21% of the articles have a theoretical or methodological object of study. Lerman (2001) is an article categorized as having a theoretical focus, as suggested by, "this article will present a cultural, discursive psychology for mathematics education" (p. 87). This does not imply that no data are presented but rather that such data are used to exemplify the theoretical lines of argumentation.

To be explicit, the general argument here is not that discourse analysis is better, in any general sense, than other types of analysis. The argument is that it is important to notice whether analysis of discourse is a means or an end in the study, because that affects, for instance, the ontological status of the results and conclusions.

Epistemological considerations are prioritized in Wetherell's (2001a, 2001b) introduction of discourse research. Further, Wetherell notices that several traditions have been developed for studying discourse. What follows is a discussion of how the articles relate to the epistemological discussion about the relation between discourse and knowing as well as which traditions are used to conceptualize the studies reported in the articles.

Forty-nine percent of the articles subscribe to epistemological assumptions similar to Wetherell's (2001b) first principles and therefore were placed in the discourse as Constitutive category, as shown in Table 6. Sfard (2001) may serve as an example of an article that subscribes to a constitutive view of language use, stating that "thinking may be conceptualized as a case of communication" (p. 26). Examples of other traditions used by articles in this study that belong to the discourse as Constitutive category include critical epistemology, sociolinguistics, poststructuralism, postmodern theory, sociocultural theory, theory of discourse, cultural psychology, activity theory, cognitive linguistics, discursive psychology, and ethnomethodology. There are complicated relations between and within these traditions, but it is beyond the scope of this article to delve into such discussions. However, what these traditions have in common is that they do not view language use as a reflection of reality but, instead, stress the constitutive and constructive function of language use in relation to phenomena in the world.

Table 6
Types of Epistemological Assumption

Epistemological assumption	Percent of articles
discourse as Constitutive	49% (53 of 108)
discourse as a Reflection	22% (24 of 108)
Not Explicitly Situated	29% (31 of 108)

Twenty-two percent of the articles belong to other epistemological positions that do not regard language use and discourse as constructive and constitutive of reality. Most of the articles belonging to this category are situated in the epistemology of constructivism[11] and social constructivism (building on the work of Bauersfeld and Vygotsky). It may be surprising that some articles referring to Vygotsky are placed in the discourse as Constitutive category whereas others are placed in the discourse as a Reflection category. This distinction originates from the many different interpretations of the work of Vygotsky. More precisely, a distinction is made between articles using Vygotsky for arguing that social aspects, including language use, constitute cognition (first category) or influence cognition (second category) (see, e.g., Lave, 1993; Lerman, 2001, 2006; Sfard, 2006). In the first category, "students' actions are viewed as elements of a system" (Cobb, 2007, p. 23), whereas in the second category social processes are viewed as "clearly partitioned off from cognitive processes" (Cobb, 2007, p. 23).

Among the articles used in the present study, for instance, Manouchehri (2004) fits within the category of discourse as a Reflection using both Piaget and Vygotsky

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[11]In this study, it is important to distinguish between constructivism and constructionism. On a very basic level, the former typically stresses that the individual constructs knowledge, whereas the latter emphasizes that discourses construct objects and subjects (see, e.g., Shotter, 1991, 1995).

and states that "social constructivism, as proposed by Vygotsky, accounts for the role of environment and group participation in learning" (p. 39). Manouchehri's (2004) use of Piaget and Vygotsky as well as formulations such as "cognitive psychologists have studied the patterns of interaction in social settings with the intent to identify aspects of cognition that are *influenced by them*" (p. 39, italics added) are used as an argument for putting that article within the category of discourse as a Reflection. Finally, 31 of the 108 articles were not explicitly situated within any tradition and thus did not present any explicit epistemological principles. Since epistemological assumptions guide the researcher, as well as the reader of the articles, in how to conceptualize learning and its relation to constructs such as *individual*, *social*, and *discourse*, the findings of this study might be interpreted to imply that many articles might benefit from being more explicit about epistemological assumptions.

To conclude this section, I will use the findings from each of the first four analytical questions to return to the first research question: How are articles in prominent mathematics education journals focused on the concept of discourse theoretically conceptualized? The findings in relation to the fourth analytical question demonstrate that the set of articles subscribes to different epistemological assumptions of the relation between language use and reality (Wetherell, 2001b), although 29% of the articles are not epistemologically situated. The results emerging from the third analytical question indicate that many articles (75%) are engaged in what Antaki et al. (2003) and Wetherell et al. (2001a) would denote as *discourse studies* or theoretical discussions of discourse research. The results from the third and fourth analytical question indicate that the articles examined in this study are theoretically conceptualized in many different ways. If we return to the first and second analytical questions, we see that the precision used in the articles in using the word discourse is generally weak. For instance, only 19% of the articles define and/or explicitly discuss the concept of discourse. This lack of explicitness might seem problematic in relation to the number of different epistemological assumptions, definitions, topics areas, and traditions within discourse research (cf. Gee, 1996; Wetherell, 2001a, 2001b).

Research Question 2: What Data Are Used in These Articles, and How Are Those Data Analyzed?

In this section the results related to analytical questions 5–7 are presented as support for answering the second research question, What data are used and how are those data analyzed? The overview of discourse research suggested that different traditions and articles belonging to certain topic areas tend to use particular kinds of data (Wetherell, 2001a). The distribution of types of empirical material used in the articles appears in Table 7.

A majority of the articles (78%) use talk as data in analyzing discourses. This finding is not surprising but points to the relative lack of discourse studies focused on written texts in the six journals. For instance, only two articles analyze the

discourse of textbooks and no discourse analysis of syllabi or curricula was identi-fied. The third category, Other, includes purely theoretical articles, such as Zevenbergen (1996).

Table 7
Types of Data

Data type	Percent of articles
Talk	78% (84 of 108)
Written Text	9% (10 of 108)
Other	13% (14 of 108)

The substantial interest in talk as data makes it important to study the ways in which talk is transcribed. The level of detail of the transcript must be related to the specific aim(s) of the study (Jaworski & Coupland, 2005a). As Ochs (2005) argues, transcribing is seen by many researchers from the topic area of social interaction as an important part of the analysis of data. That is, analysts who have written articles classified in the first topic area, Social Interaction, typically produce tran-scripts including specific codes denoting, for instance, pause (2.1), overlaps [], >faster talk<, and stress to analyze properly details of local social interactions, whereas, for instance, Foucault-inspired researchers using talk as data typically use transcripts without annotated codes, which appear similar to ordinary texts.

As displayed in Table 7, 84 articles use talk as data. Of those 84 articles, 89% (75 of 84) use transcripts that look like ordinary texts, whereas 11% (9 of 84) use specific codes in the transcripts. The finding that 75 of 84 of articles using talk as data do not use transcripts containing specific codes is not in itself worrisome. However, 85 of 108 articles use the word *discourse* to refer to either social interac-tion or speech, as displayed in Table 4. By combining these two findings, one could claim that it is likely that many articles would benefit from using more detailed transcripts to be able to capture interactional aspects in mathematics classrooms. Further, whether or not more detailed transcripts are needed, one may argue that the quality of the article would increase if explicit discussions of the rationale for choosing ways of transcribing verbal talk were included. No such discussions could be found in the articles in the Ordinary Text category. One alternative explanation for this finding might be that researchers have used for analysis more detailed transcripts of data than those presented in the articles due to, for instance, read-ability. If this is the case, authors may want to make such choices explicit.

In mathematics education, a key issue in research is to stress mathematical aspects (e.g., Lester, 1996; Silver & Herbst, 2007). In searching for how mathe-matical aspects are accounted for in analysis of data and discussions of the results, I used the elaboration presented in the previous section on Mathematical discourses, Mathematics in discourses, and Generic Educational discourses. In defining

mathematical constructs in this way, the study shows that 48% of the articles stress mathematical aspects of discourse or conceptualize mathematics as a discourse, whereas 52% were focusing on more generic educational discourses. Hufferd-Ackles, Fuson, and Sherin (2004) is an example of an article categorized as deriving explicit mathematical constructs in distinguishing four development trajectories of discourses: questioning, explaining mathematical thinking, sources of mathematical ideas, and responsibility for learning. Among those 48%, only a few articles conceptualize mathematics itself as a discourse; I will return to this finding in the Discussion section of the article. Herbel-Eisenmann (2007) could serve as an example of an article belonging to the Generic Educational discourse category in stressing the voice of a textbook. Notice here that Herbel-Eisenmann presents how the voice of the textbook does not fully succeed in locating the authority of mathematical reasoning and justification in students. Therefore, mathematical reasoning and justification are part of the analysis but the main focus of the article is to study whether or not the voice of the textbook (use of pronouns, modality, etc.) positions students as agents in relation to reasoning and justification rather than investigating the processes of mathematical reasoning and justification.

Regarding the second research question, What data are used in these articles and how are those data analyzed?, most discourse studies use talk as data (cf. Table 7). The use of talk as data corresponds to the current emphasis in reform documents (e.g., NCTM, 2000) of developing communication in the mathematics classroom. However, this finding also indicates that there are many future opportunities for interesting discourse studies using, for instance, textbooks, curriculum, assessments, and research articles as data. One might surmise from the current study that if interactional aspects of discourses are to be studied seriously, discussions of ways of transcribing need to be more prominent. Finally, the analysis shows that the emphasis on either mathematical discourses or more generically educational discourses is fairly equally distributed among the articles.

Research Question 3: To What Extent and in What Ways Do These Articles Build on Each Other?

Results from the eighth analytical question are used in answering the third research question, to what extent and in what ways do the articles build on each other? As previously described, few articles that were examined referred to earlier published articles within the corpus of data, and few attempts were made to develop analytical approaches from other discourse studies in mathematics education. As a consequence, I conducted a reanalysis of the articles. Two measures were used to determine the extent to which these articles built on each other. First, I examined the frequency with which articles refer to earlier published articles in the corpus and, second, I examined how those references were used. In searching the reference lists of all 108 articles, a total of 71 references to articles within the corpus of articles were found. This could be compared to the potential number of references, which is about 4400.[12] If we consider that the

process of selecting the 108 articles was based on their focus on studying discourses, one could interpret the number of cocitations as an indication that the articles build upon each other theoretically or methodologically to a small extent. This interpretation is further strengthened if we take a closer look at another aspect of the references used; the most frequently referenced authors in this study: Cobb, Boufi, McClain, and Whitenack (1997) 9 times and Sfard (2000a, 2000b, 2001) 18 times.

Eight of the nine articles referring to Cobb et al. (1997) did not use that reference to develop theoretical approaches, to analyze the data/results, or to discuss the conclusions. In the ninth case, a reference to Cobb et al. (1997) is used to comment on one conclusion. In essence, articles referring to Cobb et al. (1997) were not using that reference to deepen theoretical or methodological discussions or to elaborate on the results of the study. However, there seems to be some cumulative theoretical and methodological work in relation to the works of Sfard (2000a, 2000b, 2001).[13] More precisely, nine articles within this study focus on theoretical and methodological elaborations of the "communicational approach to cognition." Among those nine articles, Anna Sfard herself is an author in four articles.

DISCUSSION

This study shows that a wide variety of theories and approaches are imported from traditions outside mathematics education to examine aspects from all three topic areas: Social Interaction; Mind, Selves, and Sense-making; and Cultural and Social Relations. On the other hand, the study also indicates that the conceptual clarity of many articles is weak and that cumulative work of developing theoretical approaches for conceptualizing and analyzing discourses is rare. One may argue that conceptual clarity is a prerequisite for cumulative development because it is very difficult to build sensibly on other articles if keywords and/or epistemological principles are not explicitly discussed. These results suggest that it is more important for future studies in mathematics education to engage in theoretically sophisticated development of already-introduced theoretical approaches than to import new approaches from other fields.[14] Both the overview of discourse research and the results of this study could be used as support for pointing out important distinctions and stressing key aspects for such future theo-

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[12]The 4400 was calculated by assuming that it was possible for a particular Article A to refer to articles published two years before Article A. For example, Article A (2004) could refer to articles published in 2002 and earlier.

[13]There are several researchers such as Cobb and colleagues and Lampert, Lerman, Radford, and Walkerdine who have been working on developing theoretical and methodological approaches for studying mathematical interactions and discourses. However, among the articles of this study, there are very few instances in which those approaches are either used or elaborated on.

[14]This is a question of priority, and there will, of course, be cases in which there are new approaches that are important to import.

retical development of discourse research in mathematics education. In particular, future discourse studies in mathematics education should define the concept of discourse; engage in epistemological considerations between language use and human knowing; consider whether discourse is a means or end of the analysis; seriously engage in describing ways of transcribing oral data; and consider how mathematics discourses are conceptualized and are related to generic educational discourses in, for instance, mathematical classroom discourse. From a different perspective, this study also documents a lack of discourse analyses of mathematical textbooks and curriculum documents as well as the relation between them (cf. Herbel-Eisenmann, 2007).

The results indicate that general features of theoretical development such as defining keywords, building on the work of others, and clearly positioning the article in epistemological perspectives are of great importance for future studies in mathematics education. The overview of discourse research and the results of the study also suggest some areas for future development specific for *mathematics* education. Many articles examined in this study are focused on the discourse in mathematics classrooms. A key issue for future discourse studies in mathematics education is the need to elaborate further on how to stress mathematics in such discourse studies, and I introduce some aspects to consider for such work. First, a distinction worth considering is the distinction between articles conceptualizing mathematics as a discourse and articles that stress mathematical aspects of classroom discourses. This study indicates that few articles conceptualize mathematics as a discourse. Even among articles that conceptualize mathematics as a discourse, different emphases and foci could be found. For instance, Moschkovich (2002) draws upon Gee (1996) and stresses different mathematical Discourses as well as practices, beliefs, and values as part of mathematical Discourses, whereas Barton (2008) puts emphasis on the relation between natural languages and mathematical discourse. In addition, Sfard (2001, 2008) and Radford et al. (2007) elaborate on epistemological questions and especially the relation between mathematical objects and semiotic sign systems, even though it is important to keep in mind that Sfard and Radford et al. use the concept of discourse differently. This suggests that future work is needed to specify how different definitions of discourse (e.g., Gee, 1996), together with different epistemological positions, affect conceptualizations of mathematics in classroom discourses as well as mathematics as a discourse. A related issue concerns the relation between mathematics as a discourse and generic educational discourses. In analyzing the articles of this study it is possible to see that there are very few attempts to analyze simultaneously mathematical discourses and generic educational discourses. One could imagine studies that, for instance, focus both on how the classroom discourse positions students as active or not active and how such positionings are related to the nature of the development of the mathematical discourses. Thus, it seems to be possible to further develop integrated theoretical approaches (cf. Radford, 2008) that would consider both mathematical discourses and generic educational discourses and how they are related to each other (cf., e.g., Moschkovich, 2002).

This study has shed some light on important aspects of discourse research in

mathematics education. However, the study has its limitations, and there exist possibilities to complement it by studying other journals or by using criteria for selecting articles. Possibilities also exist to complement this study by studying other journals or using other criteria for selecting articles. The selection of articles was limited to articles using the terms *discourse* or *discursive* in headings, abstracts, or keywords in selected influential journals within the discipline of mathematics education. It is likely that some articles using discourse traditions choose to use concepts such as *interaction*, *dialogue*, or *communication*. In addition, discourse research relevant in mathematics education might also be published in other journals, such as *For the Learning of Mathematics*, or journals typically not regarded as mathematics education journals, such as *Cognition and Instruction*, the *Journal of the Learning Sciences*, and *Learning and Instruction*. In essence, it is likely that future studies of those articles and journals will enrich and complement the critical evaluation produced in this article.

CONCLUSIONS

This article focuses on the discourse of discourse studies in mathematics education. The study shows a discourse with many different traditions focused on analyzing something called *discourse*, a concept typically not defined in articles. From a slightly more positive perspective, a growing number of studies take a discourse approach in understanding mathematics teaching and learning. Such traditions and approaches provide conceptualizations and analytical constructs useful for examining important dimensions of mathematics teaching and learning, even though more work is necessary to develop those approaches for the special needs of mathematics education. This study is meant to contribute to such a development by introducing important distinctions and suggesting areas for considerations in elaborating on theoretical approaches for conceptualizing and analyzing discourses in mathematics education.

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APPENDIX

The 108 articles that follow constituted the empirical material for this study.

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