



Different types of student comments in the mathematics classroom



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ABSTRACT

In this paper five classrooms at grades 5–7 (students aged 11–14 years) are studied for one week each during their mathematics lessons. The aim is to study the students' comments in order to develop categories describing the comments' different contributions to the mathematical discourse. The main categories developed are student initiatives, explanations, partial answers, teacher-led responses and unexplained answers. The practices analysed are all dominated by the IRE pattern (Initiation–Response–Evaluation), and the different categories of student comments can be seen as a description of the different types of 'R' (student response) from the IRE pattern. This also illustrates that different patterns can be hidden behind the IRE-label. The categories can be used to study student comments on a turn-by-turn basis, describing different types of student contribution to the mathematical discourse.

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1. Classroom interaction

1.1. Describing entire practices

Several theoretical models and concepts have been created in order to characterise mathematical discourse in classrooms. Probably the most cited is the IRE (or IRF) pattern (Cazden, 1988, 2001; Sinclair & Coulthard, 1975), describing a pattern where the teacher initiates (I), a student responds (R) and the teacher evaluates (E) or gives feedback (F). In this way, the teacher both takes the responsibility for the progress and direction of the discourse by initiating tasks and questions, and is the authority that evaluates all student responses. Two other widely cited concepts are funnelling and focusing (Wood, 1998). A teacher's questions funnel the conversation when the teacher does most of the intellectual work and 'the student's thinking is focused on trying to figure out the response the teacher wants instead of thinking mathematically himself' (Wood, 1998, p. 172). The alternative is to ask questions so that students' attention is focused on important mathematical ideas and to place the responsibility of the intellectual work on the students (Stein, Engle, Smith, & Hughes, 2008). According to Franke, Kazemi, and Battey (2007), one of the most powerful moves a teacher can make 'is one that supports making detail explicit in mathematical talk, in both explanations given and questions asked' (p. 232). However, there is a problem when describing one pattern well and collectively assigning all of the remaining patterns into one group characterised by not being IRE, or by describing only two possible patterns.

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	INTERACTIVE	NON-INTERACTIVE
DIALOGIC	A Interactive / Dialogic	B Non-interactive / Dialogic
AUTHORITATIVE	C Interactive / Authoritative	D Non-interactive / Authoritative

Fig. 1. Communicative approach (Mortimer & Scott, 2003, p. 35).

Brendefur and Frykholm (2000) move one step further by suggesting four general levels of communication. The first two levels of 'uni-directional' and 'contributive' communication both fit into the IRE description. The main difference is that in contributive communication the students are allowed to articulate solution strategies, something that rarely happens in uni-directional communication. The third level is 'reflective communication', where the intention of sharing ideas is to deepen mathematical understanding. This changes the focus from transmitting information towards generating meaning through a dialogic discourse. This is different to IRE as the student must participate in the evaluation rather than just respond to teacher initiatives. The fourth level is 'instructive communication' where the teacher and students participate closely together and alter the progress to build upon and deepen students' present understanding. To do this, the students also have to initiate questions, in addition to providing answers and participating in evaluations. In an alternative framework, Wood, Williams, and McNeal (2006) describe four patterns of communication, or four different classroom cultures. The first is the 'conventional textbook' culture, where the teacher dominates the discourse and the major interaction pattern is the IRE. The second is the 'conventional problem solving' culture which is also dominated by the teacher. The major interaction pattern in the conventional problem solving culture arises through the teacher giving hints. Such hints 'essentially removed the mathematical challenge or complexity of the problem' (Wood et al., 2006, p. 234). The third is the 'strategy-reporting classroom' culture where the students report strategies and might also be asked to provide more information about how they managed to solve a problem. The fourth is the 'inquiry/argument classroom' culture where the goal of sharing is for the listeners to ask questions for further clarification and understanding. Often these discussions include a challenge or a disagreement. In this way the students are trained in justification and assessment, and this might help them develop robust mathematical arguments and reasoning.

Both the framework describing four levels of communication (Brendefur & Frykholm, 2000) and the framework describing four classroom cultures (Wood et al., 2006) provide more finely grained sets of concepts than simply describing a classroom discourse as IRE or not. There are also many similar observations in these two frameworks, especially as both differ between patterns based on how students contribute to the discourse. Mortimer and Scott (2003) have also provided a framework describing a teacher's communicative approach (Fig. 1). This model includes two dimensions, the dialogic–authoritative dimension and the interactive–non-interactive dimension. Dialogic communication refers to a situation where more than one point of view is paid attention to, while authoritative communication is where the attention is focused on only one point of view and 'there is no exploration of different ideas' (Mortimer & Scott, 2003, p. 34). Interactive communication means that other people are allowed to participate while non-interactive communication excludes other people from participating. The result of combining these two dimensions is that there are four possible communicative approaches. The first is the approach that is both dialogic and interactive, where several points of view are paid attention to and people are allowed to participate actively. The second is the non-interactive and dialogic approach, where several points of view are paid attention to but without allowing others to participate. This could occur when a teacher presents several points of view and discusses these without allowing students to participate actively. The third is the interactive and authoritative approach, where the participants are allowed to participate but only one point of view is paid attention to. The fourth is the non-interactive and authoritative approach, where only one point of view is attended to and no other people are allowed to participate.

The above frameworks provide us with concepts to describe entire practices or sequences of a discourse at a certain level of generality. However, two main challenges arise when these are used to characterise classroom interaction. One challenge is that entire practices or longer sequences often include comments that point out different directions. For example, a sequence is rarely either interactive or non-interactive and is rarely either dialogic or authoritative, but quite often something in between. Another challenge is that when used to study these different comments in detail, the above frameworks are not detailed enough to describe observed variations within each category. This is also illustrated by Wells (1993) who argues that the IRE pattern is treated too undifferentiated and "as if all the occasions when it occurs are essentially similar" (p. 3). By using examples from the classroom, Wells (1993) demonstrates how much variation that is hidden within the IRE pattern, and that this also includes qualitatively different initiatives, responses, and evaluations. This indicates that within IRE there might be teachers dominating, but there also might be room for student contributions beyond answering teachers' questions and beyond evaluations limited to correct and incorrect.

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