



Managing differences by focusing on communication qualities: Pupils learning mathematics in pairs at a computer



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ABSTRACT

The article presents a study of face-to-face verbal communication when pupils work with geometry in pairs and share a stand-alone computer with Geoboard software. The work sessions of pairs of 9th grade pupils are video recorded, and a screen recorder is used to capture their computer activity. The study focuses on identifying and characterizing good communication practices that enhance mathematics learning through joint research reflections between the pupils, the teacher, and the researcher. The major finding concerns how two of the pupils have diverging perspectives on how to communicate mathematics, yet they manage to have productive collaboration. The differences generate collaborative challenges for the pupils and an opportunity to discuss how pupils' communication qualities can prove important in fruitfully managing such challenges.

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1. Rationale and research question

Communication as a field of study has a rich and long history, as evidenced for instance by Socrates in Plato's dialogues and the sophists' studies of and treatises on rhetorics. The term *communication* stems from the Latin verb *communicare*, meaning *to share* or *to make common*. There is an increasing focus, internationally and nationally, in curriculum reforms on communication. In the USA, communication is embedded in two of the new processes in the Common Core Standards for mathematical practice. An example is the focus on justifying and communicating conclusions and responding to other's arguments. The importance of spoken language in pupils' mathematical development is emphasized in the national curriculum in England. In the Chinese Ministry of Education's curriculum reform (2010) it says pupils should "develop their abilities to . . . communicate and cooperate with others" (p. 2). The national curriculum (Ministry of Knowledge, 2006) in Norway increased the focus on communication by emphasizing the ability to *express oneself orally* as one of five basic competencies in every school subject. However, international research (e.g. Galton, Hargreaves, Comber, Wall, & Pell, 1999; Newton, Driver, & Osborne, 1999; Wegerif, 1996) as well as national research (e.g. Alseth, Breiteig, & Brekke, 2003; Grønmo, Onstad, & Pedersen, 2010; Vavik et al., 2010) on the learning of mathematics and science in schools show that little time is assigned to sharing subject matter knowledge through talk. This constitutes the rationale for studying communication in mathematics learning.

Today, most international curriculums include Information and Communication Technology (ICT) to a greater or lesser degree. When the 2006 education reform was implemented, Norway became the first country in the world where digital competence was singled out as a basic competence. However, an overview of the digital conditions in Norwegian schools by Hatlevik, Ottestad, Skaug, Kløvstad, and Berge (2009) showed that how computers are used, and the amount of use, varies between schools, teachers, and subjects. Thus, more research on pupils' communication in computer settings is needed. This

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study focuses on identifying and characterizing good communication practices when pupils use a computer. The research question is: *What characterizes communication qualities, if any, that can enhance a pair of pupil's mathematics learning at a computer?*

The design is inspired by design-based research, and the terms characterize and enhance in the research question reflect how design-based research “blends empirical educational research with the theory-driven design of learning environments” (The Design-Based and Research Collective, 2003, p. 5). “Communication at a computer” means face-to-face communication when pupils, usually in pairs, “work on the same computer based problem at the same time” (Crook, 1994, p. 148). The pupils’ different perspectives on how to solve mathematical tasks and their communication qualities and productive collaboration are investigated. A core of the methodical approach is the joint reflections between the pupils, the teacher and the researcher. Wegerif (2004) modified the IRF communication structure into an IDRF structure (Initiative, Discussion, Response and Feedback). The IRF part is pupil-computer interaction, while the D part is pupil-pupil talk where pupils spend time discussing an issue rather than giving an immediate response to the computer’s initiative. This study focuses on the D part.

The study follows a semiotic perspective and the aim is particularly to map and investigate communication characteristics related to three themes: (1) reciprocal perspective setting and taking, (2) questions and framing utterances in a questioning manner, and (3) continuing on each other’s utterances. These three themes derive from the work of Bakhtin (1986), Bakhtin and Holquist (1981), Gadamer (2004), and Rommetveit (1992) and will be elaborated in the next section. The following sections on theory, research, and analysis are structured according to these three themes.

2. Theoretical background and conceptual framework

The study is based on a semiotic perspective in which knowledge is developed through an exchange of meaning and contrasts the transmission model of communication (Fiske & Jenkins, 2011). Communication between individuals is regarded as a fundamental element for development. Several thinkers emphasize in this respect the importance of language (verbal and nonverbal): “Language is the universal medium in which understanding occurs” (Gadamer, 2004, p. 390). Skjervheim (1996) underlined that humans have language, and human interaction and development takes place mainly *by means of* language and *in* the language. This corresponds with Bakhtin’s (e.g. 1981) focus on how language can enhance dialogue.

2.1. Reciprocal perspective setting and taking

The focus in this article on presenting perspectives; thinking aloud and expressing one’s reasoning, is inspired by Rommetveit (1992). His work is influential to a dialogic approach to communication, and the following quotation shows key aspects of Rommetveit’s theoretical contribution:

Reciprocal adjustment of perspectives is achieved by an ‘attunement to the attunement of the other’ by which states of affairs are brought into joint focus of attention, made sense of, and talked about from a position temporarily adopted by both participants in the communication. (1992, p. 23)

According to Rommetveit, establishing a joint focus towards a subject matter and creating a space for communication are key issues for developing dialogic collaboration. In order to establish and maintain such a joint focus and a collaborative space, Rommetveit argued for the importance of *reciprocal perspective setting and taking*. This reciprocity is dependent on a person’s abilities and willingness to bring a subject matter into language and to listen actively. One needs to facilitate contexts in which “some aspect is brought into focus by one participant and, as a consequence, jointly attended to by both of them” (Rommetveit, 1992, p. 23).

The focus in this article on having different perspectives relates to Bakhtin’s (e.g. 1981) focus on the tension between the internally persuasive word and the authoritative word. The authoritative word demands acceptance independently of its convincing power, whereas the internally persuasive word “is affirmed through assimilation, tightly interwoven with one’s own word” (1981, p. 345). The authoritative word is static and isolated – it is monologic – while the internally persuasive word is interactive and opens up for continuous interaction. Wegerif, referring to Bakhtin (1986), argued that “it is the difference between us in a dialogue that makes the meaning flow; if you fill this difference in with ‘common ground’ then the flow of meaning will stop” (Wegerif, 2011b, p. 86). The “mutuality of differences” can be regarded as a key to understand Bakhtin’s concept of dialogue (Holquist, 2002, p. 41). A dialogic approach acknowledges the coexistence of diverging understandings.

2.2. Questions and framing questions in a questioning manner

The focus on *questions and framing utterances in a questioning manner* is inspired by Bakhtin (1986) and Gadamer (2004) in particular. Bakhtin focused on a questioning attitude, “an open, dialogic attitude” (Bakhtin, 1984, p. 251). Gadamer and Linge developed concepts as openness and listening, and argued that openness and the ability to listen require a particular focus towards questions: “the differentia between methodological sterility and genuine understanding is imagination, that is, the capacity to see what is questionable in the subject matter and to formulate questions that question the subject matter further” (1977, p. xxii). One needs the ability to see what is questionable.

Gadamer (2004) argued for the importance of asking real questions. To ask real questions is important in order to generate authentic dialogue, and means “to bring into the open. The openness of what is in question consists in the fact that the answer

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