Expert design and implementation of effective classroom discussions for formative assessment

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We present the first results of a long-term study aimed at characterizing an expert design and implementation of effective classroom discussions for formative assessment. For the analysis of the data collected in this study we combine the use of three different theoretical constructs concerning: the expert teacher's roles during classroom discussions; shared attention; formative assessment key-strategies. The presented results concern, on one side, the expert's use of a specific digital technology (an interactive whiteboard) to empower specific teacher's roles to promote shared attention and, on the other side, the effects of the empowered teacher's roles in the activation of specific formative assessment strategies.

Keywords: formative assessment, classroom discussion, teacher's roles, shared attention.

Introduction and theoretical background

In this contribution we present the first results of a long-term study aimed at characterizing an *expert* design and implementation of *effective* classroom discussions for formative assessment (FA).

We conceptualize teacher's expertise by referring to Mason and Spence (1999). Specifically, in our perspective, an *expert* design and implementation is realized by a teacher who knows-to as well as knows-how "to create suitable conditions and then to direct student attention effectively" (p. 147). This is linked to the teacher's awareness of the fact that "it is so vital for students to have the opportunity to be in the presence of someone who is aware of the awarenesses that constitute their mathematical 'seeing'" (p. 151).

In our perspective, classroom discussions are *effective* for FA if they support the activation of *FA key-strategies* (Wiliam & Thompson, 2007): (A) clarifying and sharing learning intentions and success criteria; (B) engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding; (C) providing feedback that moves learners forward; (D) activating students as instructional resources for one another; and (E) activating students as the owners of their own learning.

In line with Mason and Spence's (1999) ideas, our hypothesis is that promoting *shared attention* may foster fruitful FA processes. This is in tune with recent studies, developed in the field of mathematics education, on the role of moments of joint attention in fostering students' acquisition of a culturally appropriate meaning of mathematical objects (Shvarts, 2018; Salminen-Saari et al., 2021). To define shared attention, scholars (Shteynberg, 2015, Siposova and Carpenter, 2019, Fredriksson, 2022) stress on the crucial difference between the social-cognitive processes that take place when people

act as detached observers of each other (third-person perspective), and the processes in which individuals interact by adopting an engaged attitude towards each other (second-person perspective).

Fredriksson (2022) emphasises that, when shared attention is realised, "a first-person perspective may develop into a we-perspective in which it is not an I, but "a we", that is attuned to the world" (p. 115). In shared attention, two different beings "find the same attunement with the world" (p. 114) and acknowledge the commonality of their world.

To characterize the expert design and implementation of effective classroom discussions, we have analysed a large amount of data collected during the FaSMEd Project (Cusi, Morselli & Sabena, 2017), during which we carried out teaching experiments focused on the use of connected classroom technologies and Interactive Whiteboards (IWB) to support teachers' FA practices.

The data analysis has been developed by referring to a theoretical construct useful for interpreting and analysing teachers' roles, namely the *Model of Aware and Effective Attitudes and Behaviours, $M_{AE}AB$* (Cusi & Malara, 2013, 2016). The $M_{AE}AB$ construct identifies two main groups of roles that an expert teacher intentionally plays, during a classroom discussion, with the main aim of "making thinking visible" and of stimulating metacognitive reflections. The first group of roles are those that the teacher plays in order to pose him/herself as a model by making visible the hidden thinking, the aims, the meaning of the strategies, and the interpretation of results when facing problems: (1) investigating subject and constituent part of the class; (2) practical-strategic guide; (3) activator of interpretative processes; (4) activator of anticipating thoughts. The second group includes the roles that the teacher plays when he/she stimulates metacognitive reflections to help students become aware of the meaning of the realized activities and of the learning processes themselves: (5) guide in fostering a harmonized balance between the syntactical and the semantic level; (6) reflective guide in the identification of effective practical-strategic models; (c) activator of reflective attitudes and meta-cognitive acts.

Research method

Within the FaSMEd project, the teaching experiments took place in 36 classes encompassing students from 4th to 7th grade, across two consecutive school years (2014–15 and 2015–16), in three school clusters in north-western Italy. We collaborated with 20 teachers to collect approximately 450 hours of classroom sessions. During the teaching experiments, the role of the expert was played by a researcher, one of the authors, in line with the Italian paradigm of research for innovation (Arzarello & Bartolini Bussi, 1998), which theorizes the elimination of the classical distinction between observer and observed (on one side, the class, including the teacher, and, on the other side, the researcher).

We collected lesson's video recordings, observers' field notes and students' written answers. Video recordings and their transcripts form the data corpus for the part of the study documented in this paper. The transcripts were analysed separately by the three authors. Non-converging elements of the analysis were discussed further so as to reach an agreement. We combined the use of the aforementioned theoretical constructs to study how the expert teacher designs and implements classroom discussions through the support of an IWB to empower the $M_{AE}AB$'s roles by promoting shared attention that fosters fruitful FA key-strategies. More specifically, the expert's interventions:

- were analysed according to the M$_{AE}$AB construct (Cusi & Malara, 2013, 2016);
- were related to the foci of shared attention (Fredriksson, 2022) that they aimed to promote;
- were linked to their effects in terms of the FA key-strategies (Wiliam & Thompson, 2007) activated by means of these interventions.

In this 4-pages presentation we confine ourselves to outline the main results for the analysis. The analysis of a paradigmatic example will be added in the oral communication.

Results and discussion

The first set of results concerns the expert's use of the IWB to empower specific M$_{AE}$AB roles to promote shared attention. We found that specific uses of the IWB and other specific expert's actions empowered most of the M$_{AE}$AB roles: zooming-out and/or scrolling from top to bottom to provide an overall view of the groups' answers; zooming-in to focus on particular answers; scrolling up to focus on elements of the given task; inviting one student to come to the IWB to comment on his answer focusing on both the answer and the text of the task; standing in front of the IWB, reformulating a student's discourse and repeating her/his gestures. These uses and actions promote shared attention on different foci: the task and its elements; the overall distribution of students' answers (collective product); a specific written answer (single product) and its characteristics; the approach taken by a student to solve the task (past thinking process); in current approach and reflection on the task (present thinking process).

This analysis highlighted elements of synergy between the shared attention construct and the activation of the roles introduced by the M$_{AE}$AB construct:

- the shift from the "I-perspective" to the "we-perspective" (which is an indicator of the role of *investigating subject and constituent part of the class*),
- the intentional communication about a common object of attention (i.e. a representation in the case of the role of activator of interpreting processes, a strategy or an argument in the case of the role of *activator of reflective attitudes and metacognitive acts*, the thinking processes of a student or of the teacher in the case of the roles of *reflective guide* and *practical-strategic guide*),
- the focus on metacognitive processes.

The second set of results concerns the effects of the empowered M$_{AE}$AB roles in the activation of specific FA strategies. The roles of activator of reflective attitudes and metacognitive acts and of reflective guide, contribute to the promotion of specific FA strategies. For instance, teachers can encourage shared attention on a subset of responses, fostering peer assessment among students and thereby promoting FA strategy D. Additionally, students are encouraged to offer feedback to one another, thus realizing FA strategy C. Teachers may also prompt meta-level reflections on provided answers or the reasoning behind them, encouraging students' self-assessment and thus promoting FA strategy E.

In the same way, we found examples of links between the role of guide in fostering a harmonized balance between the syntactical and the semantic level and FA strategy A, and the roles of operative-strategic guide and activator of interpretative processes and FA strategy E.

This study has two implications: (1) at the theoretical level, the study shows the effectiveness of combining the $M_{AE}AB$ construct and the construct of shared attention to gain insights into the ways in which the expert teacher may promote FA during classroom discussions; (2) at the pragmatic level, this combination could provide a tool for teacher professional development aimed at promoting teachers' autonomous design and implementation of effective classroom discussions for FA.

References

Arzarello, F., & Bartolini Bussi, M. (1998). Italian trends of research in mathematics education: A national case study in the international perspective. In J. Kilpatrick & A. Sierpinska (Eds.), *Mathematics education as a research domain: The search for identity* (vol. 2, pp. 243–262). Kluwer.

Cusi, A., & Malara, N.A. (2013). A theoretical construct to analyze the teacher's role during introductory activities to algebraic modelling. In B. Ubuz, C. Haser & M.A. Mariotti (Eds.), *Proceedings of Cerme 8* (pp. 3015–3024). Middle East Technical University and ERME.

Cusi, A., & Malara, N.A. (2016). The Intertwining of Theory and Practice: Influences on Ways of Teaching and Teachers' Education. In L. English, & D. Kirshner (Eds.), *Handbook of International Research in Mathematics Education 3rd Edition* (pp. 504–522). Taylor & Francis.

Cusi, A., Morselli, F., & Sabena, C. (2017A). Promoting Formative Assessment in a Connected Classroom Environment: Design and Implementation of Digital Resources. *ZDM - Mathematics Education*, *49*(5), 755–767.

Fredriksson, A. (2022). *A Phenomenology of Attention and the Unfamiliar Encounters with the Unknown*. Palgrave Macmillan.

Mason, J. & Spence, M. (1999). Beyond mere knowledge of mathematics: the importance of knowing-to act in the moment. *Educational Studies in Mathematics*, *38*, 135–161.

Salminen-Saari, J. F. A., Garcia Moreno-Esteva, E., Haataja, E., Toivanen, M., Hannula, M. S., & Laine, A. (2021). Phases of collaborative mathematical problem solving and joint attention: a case study utilizing mobile gaze tracking. *ZDM - Mathematics Education*, *53*, 771–784.

Shteynberg, G. (2015). Shared attention. *Perspectives on Psychological Science*, *10*(5) 579–590.

Shvarts, A. (2018). Joint attention in resolving the ambiguity of different presentations: a dual eye-tracking study of the teaching-learning process. In N. Presmeg, L. Radford, W.-M. Roth & G. Kadunz (Eds.), *Signs of Signification. Semiotics in mathematics education research* (pp. 73-102). ICME-13 Monographs. Springer.

Siposova, B., & Carpenter, M. (2019). A New Look at Joint Attention and Common Knowledge. *Cognition*, *189*, 260–274.

Wiliam, D., & Thompson, M. (2007). Integrating assessment with instruction: What will it take to make it work? In C. A. Dwyer (Ed.), *The future of assessment: Shaping teaching and learning* (pp. 53–82). Lawrence Erlbaum Associates.