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Conditions fostering productive disciplinary engagement during a regular physics lesson in a depressed area school

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Extended summary

Research rationale

To understand the teaching and learning phenomena, it is interesting to examine what happens in schools located in sensitive urban areas. In fact, these phenomena are easier to observe in a Priority education zone, as opposed to an ordinary school, because all that occurs is amplified, as through a magnifying glass (Rochex, 1997).

In these kinds of schools, the teachers have to deal with a paradox between a learning logic and the logic of engagement in learning. The latter is favored by an immediate achievement in the set tasks. This occurs more easily when the tasks are simple and closed, but they do not lead to real disciplinary learning.

However, some teachers desire to really teach in these schools; indeed, they intend to foster student's engagement without sacrificing real disciplinary learning. It is interesting to observe how they carry it out in practice.

Theoretical frame

For this, we can use the theory of didactic action (Sensevy and al., 2005, Sensevy, 2007) which models what happens in a didactic system, the irreducible three-way relationship linking teacher, students and a piece of knowledge to be taught and learned. According to this theory, the teacher continuously negotiates with the students about the knowledge objects at stake in the interactions, and we can account for these transactions describing three dynamics, evolving in concert:

- The mesogenesis, which concerns the joint construction by the teacher and the students of the “*didactic milieu*” in which the study takes place. With Brousseau (1997), we consider that the milieu is “*all that the students relate to at the learning moment*” (e. g. material elements like light sources, screens, book etc., and symbolic and cognitive elements like already known notions, conceptual network, etc.);
- The chronogenesis, which concerns the time evolution of knowledge in the classroom;
- The topogenesis, which concerns the respective teacher's and students' responsibilities for the progress of the knowledge in the class.

To characterize the student's engagement, we use the criteria proposed by Engle and Conant (2002) to identify “productive disciplinary engagement.” According to them, students are engaged when they try to make significant contributions to the topic under discussion, when their contributions are

coordinated with each other rather than independent, and when they are very few to be involved in unrelated “off-task” activities. Their engagement is “disciplinary” when it is possible to connect the students’ discourse with what is usually scholarly discussed in physics, and their engagement is “productive” when we can notice a progress in the students’ knowledge (use of more advanced arguments, emergence of more elaborated questions, etc.)

Methodology

To answer our question, we gathered various data: video of the first teaching lesson on geometrical optics (grade 7), interviews with the teacher (very experienced in this kind of school) before and after the lesson, interviews with some representative students after the lesson, the curriculum, research results about students’ misconceptions and other difficulties with this topic. All the interactions between the teacher and students were transcribed verbatim and analyzed to identify meso, chrono and topogenesis, and their evolution during the lesson. To validate our inferences, we crosschecked them with the teacher’s interviews and the content analysis of the national curriculum related to the knowledge at stake. Lastly, we analyzed the students’ interviews, and the students’ conversation and behavior during class activities to check for the existence of productive disciplinary engagement for each of them.

Findings

The analysis of the interactions reveals that the students played a role in the topogenesis and showed productive disciplinary engagement, quite uncommon in these classes which are often very difficult to teach. If a student was off-task, it was very brief, and most of the students contributed to the progress of knowledge: they argued about the topic put under discussion by the teacher, and the discourse of one interacted with those of the other [sometimes answering each other, sometimes side by side]. They collectively tried to interpret the experiments and to put into words new questions, and after that they individually tried to formalize the description and the interpretation of the experiments. Moreover, after the lesson they could sum up its main points.

The analysis of the interactions also reveals particular ways this teacher managed the class: she problematized the topics under discussion, she based the exchanges on a collective maieutical process, she prioritized a dialogical communication (Mortimer and Scott, 2003), she facilitated the students’ reasoning, clearly identifying the knowledge at stake in each step, delimitating the elements submitted to discussion, highlighting the relevant features of the learning situations, frequently institutionalizing knowledge as it progresses, and concluding herself the exchanges when they became fruitless and demotivating. In point of fact, students contributed to the didactic action, which was a joint teacher-students action. In addition, the mesogenesis was elaborated in common, the topogenesis was shared, and the chronogenesis was carefully and deliberately slowed down due to the various exchanges. Lastly, there were very few disciplinary problems.

Discussion

We claim that the productive disciplinary engagement we observed in this particular class can be related to the nature of its instruction. In fact, the teacher put into practice the four principles

proposed by Engle and Conant (2002) to obtain productive disciplinary engagement inside a learning community: (1) problematizing the learning environment, (2) giving authority to students in addressing such problems, (3) creating students' accountability to disciplinary norms and sometimes to others, and due to those three conditions, (4) giving rise to a relevant "*didactic milieu*" (Brousseau, 1997) which might be related to the notion of "resources" in Engle and Connant's model.

Conclusion

This study (micro-analysis centered) has contributed to identifying configurations of the didactic action that seems to facilitate productive disciplinary engagement during a physics lesson developed in a school located in an urban sensitive area. We assume that our findings are also valid for a lesson taking place in an ordinary school, even these configurations are less critical for the progress of knowledge in such cases. This study also highlighted the fact that the creation to a relevant didactic milieu associated to PDE is always the result of an unsteady balance (Venturini & Amade-Escot, submitted).

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