

Scientific-cultural inquiry in school scientific activity

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Abstract.

In this paper, we present an example of an inquiry-based science education, particularly it suggesting a learning context in which students have the opportunity to develop and analyze the products of a school investigation. We present an inquiring teaching-learning sequence to deal with the problem of measure the angle of a steeped street. As results, we show that during the activities, the students not only elaborated suitable models of the street, but also developed meanings that surpassed school science.

1 Introduction

In this research, we examine a pedagogical interventions regarding angles measurement. Drawing on cultural-historical activity theory, we use three categories derived from close, yet different, theoretical traditions (Lago & Mattos, 2018). We provide an example of how ninth grade students are intensively engaged in learning and observing and measuring angles of a steeped street. We shall shed light in the discussion about the dichotomy between theoretical (discursive) and practical (active) activities. This research is a twofold task since we are concerned to break away with typical Physics lessons and producing new theoretical elements to re-frame Physics education in cultural-historical research tradition. From a Vygotskyan point of view, language is not only medium to communication, but also a mean of orienting ourselves toward an interaction situations and a process of self-creation through activity. Cognitive development in learning activities is formed in and through participation in social, culturally and historically situated practices.

2 Theoretical and methodological framework

2.1 CHAT

This research is grounded on the cultural-historical activity theory (CHAT), which provides analytical elements for understand Physics teaching-learning. It is important to underline the mutual determination of the teaching and learning activities. It implies that the learner's activity, its object, goals, motivation and utterance production are necessarily related by and confronted with the teacher activity and ultimately the completely schooling process. In CHAT perspective, the role of *mediation* is central to teachers and students, making use of different artifacts develop their joint activity. Therefore, researchers must pay attention in how teachers

and students start to share specific artifacts that makes the teaching-learning process possible and sustainable through time. We used three categories (Engeström, 2005) from different trends in cultural-historical theory that can be understood as contexts for learning to build the learning sequence: (i) *Discovery* that is related to developmental teaching and the focus is the theoretical elaboration of a certain concept from the study of their particular relations and successive generalizations and reductions; (ii) *Application* considers learning as the continuous and increasingly central participation of an individual in social practices; and (iii) *Critic* that is related to expansive learning, where the object of study is enlarged, and the focus ceases to be on the immediate object to be the learning context of its production.

2.2 Scientific-Cultural investigative activities

The activity consisted on the measurement of the inclination angle of a steeped street nearby a school. An apparently simple situation of going up and down to reach the school entrance that students experienced everyday, showed itself as a complex problem with deep epistemological implications. The students used different experimental methods trying to measure the angle. The different solutions and methods developed was latter confronted during the classroom discussion while the concept of “angle” emerged from teacher-students dialogue. The measurement process with different instruments made possible identify the appropriation and articulation of different speech genres that were used to build in, collectively, a more complex object (angle of the steeped street).

3 Results

The results shows that students were engaged in a collective production of a share activity object in both interventions. Interestingly, it become clear to the students during the teaching-learning process, that modeling and measuring are not about finding the correct and unequivocal answers for a specific task, nonetheless they are it is the production of a richer and multi-determined utterance mediated by a variety of different instruments to measure the slope of the street. Furthermore, our propose is to look at science learning as an appropriation of a specific genre which makes possible the articulation of many others discursive forms that students crosses in their communicative interactions. Then, the appropriation of the scientific knowledge and the formation of scientific concepts are after all the capability to interweave a myriad of way of talking about science. Finally, supported by our results we could propose a synthetically approach to overcame the supposed dichotomy between discourse and activity.

4 Conclusion

The three categories indicated by Engeström might provide useful insights in the development and improvement of Physics teaching-learning sequences. The results showed that it could be used in two different levels in the instruction process. On the one hand, it works as a general guideline to build and improve already existing activities. On the other hand, it is a useful tool for assessing the didactical intervention.

References

- [1] Engeström, Y. (2005). Non scolae sed vitae discimus: Toward overcoming the encapsulation of school learning. In *An introduction to Vygotsky* (pp. 157–176). New York, NY: Routledge.
- [2] Lago, L; Mattos, C. (2018). *Contribuições da Teoria da Atividade para o Ensino Investigativo de Ciências: uma sequência didática sobre as fases da Lua*. Submitted manuscript.