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DIDACTICAL SUITABILITY CRITERIA USED BY ITALIAN TEACHERS IN LESSON STUDIES

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This paper aims to identify the Didactical Suitability Criteria used by a group of Italian teachers participating in Lesson Studies. The written reflections and report documents - such as the Lesson Plans - are qualitatively analysed. The results suggest that all the Didactical Suitability Criteria are considered: the Epistemic, Cognitive, Interactional and Ecological criteria are particularly prominent; the Emotional and Mediational criteria sporadically appear. These criteria are shared in the practices of these teachers, but implicitly considered. As the Didactic Suitability framework makes them explicit, we suggest that it can be implemented in Lesson Study procedures as a guide for the a-priori analysis of contents, objects and practices.

INTRODUCTION

Lesson Study (LS) (Huang, Takahashi & da Ponte, 2019) is a teachers' professional development methodology focused on the collaboration and co-responsibility of teachers and researchers involved in students' learning. Many theoretical lenses can be used to investigate the role of teachers' reflection in the improvement of teaching and learning in mathematics, such as: the competence to look meaningfully (Mason, 2002), the methodology of the Study of the Concept (Davis, 2008) and Didactical Suitability in the Onto-Semiotic Approach (OSA) of Mathematical Knowledge and Instruction (Godino, Batanero, & Font, 2019). The main aim of this work is to analyse which Didactical Suitability Criteria (DSC) were used implicitly by a group of Italian Primary school teachers in their Lesson Plans (Bartolini Bussi, Bertolini, Ramploud & Sun, 2017), developed in an experiment to which they were involved.

THEORETICAL FRAMEWORK

The Didactical Suitability Criteria (DSC)

From the perspective of the theoretical principles and tools developed by the OSA, answer the following general question on the prescriptive nature of the consolidated results of scientific research in Mathematics Education: to what extent, how and under which conditions can (or must) didactics set value judgments and normative prescriptions in order to provide criteria on how to organize and manage study processes? In this framework, it was decided to embrace the prescriptive and evaluative view of the Mathematics Education basing on the generation of theoretical constructs. DSC arise as an answer to the following question: what kind of actions and resources should be implemented in teaching processes to optimize mathematical learning?

General criteria of suitability are divided into six partial criteria, each of them characterized by components (Breda, Pino-Fan & Font, 2017): 1) Epistemic Suitability refers to the teaching of "good mathematics". In order to achieve this, in addition to considering the official curriculum, one can refer also to those pieces of mathematics that have been concretely incorporated in the curriculum.

2) Cognitive Suitability refers to the extent to which designed learning develops within the parameters of the students' potential development, as well as the correlation between what the students indeed learn and the designed learning. 3) Interactional Suitability is the extent to which the means of interaction allow conflicts of meaning to be identified and solved and how interaction methods favour and autonomous learning. 4) Mediation Suitability is the degree of availability and aptness of time and material resources necessary for the development of teaching-learning processes. 5) Emotional Suitability refers to the degree of the students' involvement (interest, motivation) in the study processes. 6) Ecological Suitability is the extent to which the process of study is adapted to the institutional curriculum, namely to the curricular norms, as well as to the social environment.

Lesson Study (LS) in Italian context

In a LS cycle in Italy, teachers meet with a common challenge about their students' learning and (or) their professional development. After planning, designing, implementing and observing a lesson, they examine and discuss what they have observed throughout the entire process. Through multiple iterations of the lesson, teachers have many opportunities to discuss students' learning and how teaching affects it. Each cycle of the process consists of four stages: 1) Definition of educational goals and lesson planning: a group of teachers choose the topics to be developed, set the objectives and draw up the detailed Lesson Plan. 2) Research lesson implementation and observation: a teacher teaches class while others observe and record the teaching-learning process. 3) Reflection and discussion on the collected data: the teachers meet to discuss about the lesson, the attitudes of the students and the teacher during the class and to metabolize what they have learned. 4) Redesign: starting from the discussion and considerations of the group, a new lesson can be planned.

Each new lesson cycle has fresh features. They are the result of the reflections developed in the previous cycle, especially because each cycle develops in a different context. In Italy, in fact, the Constitution enshrines *freedom of the arts and sciences, which may be freely taught*. The personality of the teacher, the attitudes and previous mathematical knowledge of the students, the needs of the class, together with the reflections of the previous cycle, build the new research lesson, and none of these aspects can be overlooked in the design.

Moreover, from the research perspective of this study, it is important to point out that in Italy by law teachers' professional development is *mandatory, permanent and strategic*, and demands for the *establishment of adequate networks for professional collaboration*, focusing on the needs of teachers. In this context of interest for the professional development of the teacher, the introduction of the LS methodology can be a useful strategy for the research community in the continuous development of a culture of collaboration between researchers and Mathematics teachers.

METHODOLOGY

The study was conducted in northern Italy with the participation of five primary teachers, three first grade teachers (M1, M2 and M3), a third-grade teacher (M4) and a participating-teacher (Arzarello & Bartolini Bussi, 1998), who is now retired. In the first session, the LS methodology was presented to the teachers and the contents of the lesson were chosen. The second meeting was dedicated to the training of the group in the mathematical contents of the first set of lessons: the institutionalization of the + sign. In the third meeting, the LS cycle began.

In this research, the qualitative analysis of the teachers' responses to the items of the Lesson Plans is carried out. The items guide the participating teachers in planning, observing and redesigning the multiple iterations' stages of the LS cycles.

To analyze the teachers' reflections, we first sought to select considerations they applied to ground the lesson they proposed in their classes. Secondly, we analyzed whether these reflections can be considered as evidence of implicit use of some of the DSC's components. Finally, this analysis was triangulated with an expert in the use of DSC. It is important to note that, although a total of four teachers participated in the four cycles of the LS, the analyses carried out in this paper refer to the items corresponding to the implementations of teachers M1, M2 and M3, because they worked in the same primary first grade. Moreover, due to limitation of space, in this work only the analysis of two items is presented: *context* and *purpose of the observation*.

RESULTS AND DISCUSSIONS

The *content of the lesson* consisted of institutionalizing the + sign in the context of coins and prices. In the *context* item of the Lesson Plan, the teachers specify in which classroom context the research lesson is inserted: *The activity is part of the didactic process of meaning construction of operations for which a considerable amount of time and previous activities are recognized in the Italian curriculum before the introduction of signs into mathematical language* (M1's Lesson Plan). In this evidence, the teachers consider that the lesson should be related to the Italian curriculum, an "adaptation to the curriculum" component of the Ecological Suitability. Furthermore, they consider that time must be allocated to previous activities before implementing mathematical language, i.e. they consider the "time" component of the criterion of Mediational Suitability and the "prior knowledge" component of Cognitive Suitability.

In the first cycle's *purpose of the observation*, a concern is manifested in trying to assess the appropriateness of the students' knowledge, through attitudes and verbal expressions. This aspect is related to the "learning" component of the Cognitive Suitability criterion. In the teachers' claims there are aspects related to the Interactional Suitability within the "teacher-student interaction" component, since they emphasize the importance of communication and argumentation in the classroom: *diverse rhetorical and argumentative resources are used to involve and capture the attention of students*. (M1's Lesson Plan). The "attitudes" component of Emotional Suitability is also evident, since they consider perseverance and responsibility during the realization of the activities proposed in the lesson to be important.

They saw the need to frame the lesson in a broader set of activities: *The LS is part of a path that began some months ago, which involves the construction of the most important meanings of the number (cardinality, ordinality, measure, measure of value in the currency sphere). The activity designed by the working group is part of the educational work unit "Coins and prices" [...] (M2's Lesson Plan - context)*. Teachers consider that to achieve a good construction of the number, its different meanings must be faced. This aspect leads students to a "high cognitive demand" of Cognitive Suitability, since, when working on the task, they perform several relevant mathematical processes. In addition, teachers stress the importance of the activity providing *situations that allow the usefulness of mathematics in everyday life*: component "interests and needs" of the Emotional Suitability (*[...] in this way, children will be offered a real shopping experience*).

In the third cycle, teachers thoroughly stressed the importance of contemplating aspects related to Epistemic Suitability. For example, the "errors" and "ambiguities" components; since they consider that it is necessary to observe practices that are considered incorrect from the mathematical point of view and the importance of observing ambiguities that can lead to confusion among students: *Does the teacher use incorrect terms? Does he refer to concepts not yet understood by students? Does he transfer erroneous concepts that he does not know?* (M3's Lesson Plan - *purpose of the observation*). The "didactic innovation" component of the Ecological Suitability was also taken into account in the design of the third cycle, since teachers are concerned about the used teaching in order to involve students in the teaching-learning process: *Can the teacher's teaching style involve students? Does your teaching style produce chaotic situations that encourage children's inappropriate behavior?* (M3's Lesson Plan - *purpose of the observation*).

FINAL CONSIDERATIONS

Among the participating teachers, consensus emerges on aspects that are implicitly valued as positive in a teaching-learning process. These can be reinterpreted in terms of DSC's components (Hummes, Font & Breda, 2019). Analyzing the *context* and *purpose of the observation* items of the Lesson Plans, the teachers considered all the Suitability Criteria. The Epistemic, Cognitive and Interactional are very present, to a lesser extent the Emotional and Ecological, and sparsely the Mediatonal. We project to extend the experimentation and to deepen the analysis based on the DSC, in order to elaborate mathematics teachers' professional development programs using Lesson Study methodology. The texts (e.g. Lesson Plans) are considered to contain content that, when properly read and interpreted, allows us to infer the criteria that teachers consider valuable for designing, implementing and redesigning their classes.

References

- Arzarello, F., & Bartolini Bussi, M. G. (1998). Italian trends in research in mathematical education: A national case study from an international perspective. In *Mathematics education as a research domain: A search for identity* (pp. 243-262). Springer: Dordrecht.
- Breda, A., Pino-Fan, L. R., & Font, V. (2017). Meta didactic-mathematical knowledge of teachers: criteria for the reflection and assessment on teaching practice. *EURASIA Journal of Mathematics, Science and Technology Education*, 13(6), 1893-1918. Doi: 10.12973/eurasia.2017.01207a.
- Bartolini Bussi, M. G., Bertolini, C., Ramploud, A., & Sun, X. (2017). Cultural transposition of Chinese lesson study to Italy: An exploratory study on fractions in a fourth-grade classroom. *International Journal for Lesson and Learning Studies*, 6(4), 380-395.
- Davis, B. (2008). Is 1 a Prime Number? Developing Teacher Knowledge through Concept Study. *Mathematics Teaching in the Middle School*, 14(2), 86-91.
- Godino, J. D., Batanero, C. & Font, V. (2019). The onto-semiotic approach: implications for the prescriptive character of didactics. *For the Learning of Mathematics*, 39(1), 37- 42.
- Huang, R., Takahashi, A., & da Ponte, J. P. (Eds.). (2019). *Theory and Practice of Lesson Study in Mathematics. An International Perspective*. Springer: Cham.
- Hummes, V. B., Font, V. & Breda, A. (2019). Combined Use of the Lesson Study and the Didactic Suitability for the Development of the Reflection on the own Practice in the Training of Mathematics Teachers. *Acta Scientiae*, 21(1), 64-82.
- Mason, J. (2002). *Researching your own practice. The discipline of noticing*. London: Routledge-Falmer.