



PME44 VIRTUAL

THE 44th CONFERENCE OF THE INTERNATIONAL GROUP
FOR THE PSYCHOLOGY OF MATHEMATICS EDUCATION

July 19-22, 2021

Hosted by Khon Kaen, Thailand

Virtually hosted by Technion, Israel Institute of Technology, Isreal

Proceedings

of the 44th Conference of the International Group
for the Psychology of Mathematics Education

VOLUME 3

Research Reports (H-R)

Editors:

Maitree Inprasitha, Narumon Changsri
and Nisakorn Boonsena

**Proceedings of the 44th Conference of the International Group
for the Psychology of Mathematics Education**

Volume 3

Research Reports (H-R)

Editors:

Maitree Inprasitha

Narumon Changsri

Nisakorn Boonsena

Khon Kaen, Thailand

19-22 July 2021



Proceedings of the 44th Conference of the
International Group for the Psychology of
Mathematics Education
Volume 3
Research Reports (H-R)
Editors: Maitree Inprasitha, Narumon Changsri,
Nisakorn Boonsena

Cite as:

Inprasitha, M., Changsri, N., & Boonsena, N. (Eds). (2021). *Proceedings of the 44th Conference of the International Group for the Psychology of Mathematics Education* (Vol.3). Khon Kaen, Thailand: PME.

Website: <https://pme44.kku.ac.th>

Proceedings are also available on the IGPME website: <http://www.igpme.org>

Copyright © 2021 left to authors

All rights reserved

ISBN 978-616-93830-2-4 (e-book)

Published by Thailand Society of Mathematics Education, Khon Kaen, Thailand

123/2009 Moo. 16 Mittraphap Rd., Nai-Muang, Muang District Khon Kaen 40002

Logo designed by Thailand Society of Mathematics Education

THE SEMIOSPHERE LENS TO LOOK AT LESSON STUDY PRACTICES IN THEIR CULTURAL CONTEXT: A CASE STUDY

Carola Manolino¹

¹University of Turin, Italy

This paper presents an experience of Lesson Study involving primary school teachers in a school in North Italy. Researcher will show how Lotman's Semiosphere construct can be used to analyze cultural and semiotic aspects of Lesson Study practices inserted in the Italian cultural context, as practices intended to enhance collaboration among teachers and their critical thinking on professional issues. Researcher will also show how this analysis may complement another analysis, performed in the perspective of the Chevallard's Anthropological Theory of didactics, and concerning the institutional aspects of the Lesson Study experience.

INTRODUCTION

To meet the new challenges of mathematical education related to changes in workplaces and more generally in society, the OECD "Teachers Matter" report defines "teacher quality" as the "most important school variable influencing student achievement" (OECD, 2005, p.2). In Italy, the National Plan for the Professional Development of Teachers, scheduled for 2016-2019 but still in force, considers the professional development of in-service (and pre-service) teachers "compulsory, permanent and structural" by law. In particular, the plan aims "to promote reflective thinking and collaboration" in all its forms.

The Lesson Study methodology (LS) can be considered one of the teachers' professional development methodologies suited to meet the Italian institutional requirements. Indeed, LS is "a teacher professional development approach, originating in Asia" (Huang, Takahashi, & da Ponte, 2019, p.3), that focuses on collaboration and co-responsibility. As Hummes, Font, and Breda (2018, p.69) exhaustively explain, we can consider LS as "a very broad and non-guided reflection phase of the professional development of mathematics teachers". A LS cycle is constituted of three consecutive moments: planning a lesson in a given class, teaching and mutual observation, and discussion. After this last moment, the LS working group can choose to start the cycle again for a new class. Within this cycle teachers are led, and in this free, to reflect for an improvement of the teaching and learning process of mathematics. We may observe that the need for a practice like LS is even stronger when teachers need to face the contradiction between current beliefs and new ideas. This contradiction must be resolved over time in a supportive community with mutual trust and respect. LS stimulates precisely an openly critical dialogue among educators about the teaching and learning processes collectively observed.

Besides, international studies such as the OECD-PISA surveys encourage each of us to compare deal with the results of other countries, especially in the area of mathematics, and to study teaching and teacher professional development practices that are at the heart of the educational success of these countries, analyzing whether and how there can be a correlation between student learning and teacher professional development. However, studies like those by Kim, Ferrini-Mundy, and Sfard (2012) or Bartolini Bussi and Martignone (2013), suggest that teacher professional development is not the only element that affects the quality of student learning: We must take into consideration the cultural aspects that have an impact on teacher professional development, on teaching and and learning. In this perspective, my purpose is to study Lotman's Semiosphere construct (Lotman, 1990) as a theoretical lens – prospectively networking with others – to read the cultural aspects in teachers' practices. Hence, my research questions are as follows: How and which aspects of teachers' culture, relevant for their own professionalism, are highlighted by the Semiosphere? Which elements of the Semiosphere are effective in analyzing teachers' practices?

The semiotic space is my main unit of analysis, specifically researcher will investigate how teachers' collective practice are observable in it within a LS experience: Since, as Geoffrey Saxe (2014) states, it is within collective practices where we can identify firmly the relationships between culture and cognition, and therefore between culture and reflection.

THEORETICAL FRAMEWORK

In the literature in mathematics education the systemic aspects (Font, 2002, pp.143-156) concerning the links between teaching and learning practices and organization and social constraints are the subject of important theoretical elaborations, in particular that of Yves Chevallard. His object of study is a ternary relation: the didactic system (students, teacher, mathematical knowledge), which cannot be understood except in relation to the (external) environment that surrounds it, the teaching system and society. The relationship between the system and its surroundings passes through the process of *didactic transposition* that converts scholarly knowledge, initially into knowledge to be taught and then into taught knowledge - and finally into learnt knowledge. The “intermediate area between the teaching system and society” is the space that Chevallard (1981, p.8) defined as “the noosphere: (the sphere where one thinks) about the teaching system”. Bosch and Gascon (2006) warn us, however, that it can happen that the school may lose the logic of the knowledge to be taught, i.e. the questions that motivated the creation of this knowledge, stopping at the lowest *levels* of what Chevallard has defined as *didactic co-determination* (Figure 1).

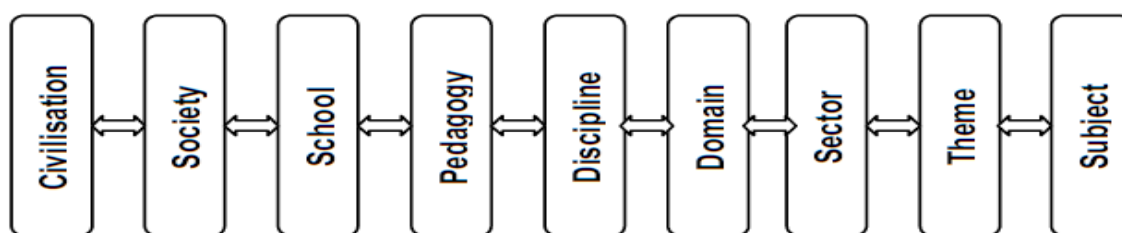


Figure 1: Didactic and mathematical co-determination levels (Bosch & Gascon, 2006, p.61).

In-service teachers' professional development, focused on critical reflection and on experiences of sharing, thinking, and collaborating, are aimed at awakening, or renewing the knowledge to be taught. Each choice, each element living within the didactic and teaching system, is dictated by one (or many) in-depth reflection on the way this content is structured and taking into account the conditions and constraints posed by the different levels of co-determination during the didactic transposition process. However, since I could not leave aside the cultural and semiotic aspects – since, furthermore, in mathematics the signs are themselves objects of mathematics –, researcher attempted to verify if in the perspective of Lotman's semiotics of culture there could exist theoretical tools suitable to account for these aspects.

According to Lotman (1990), semiotic knowledge is embedded in culture, that is a complex system of signs. Studying semiotic aspects, we study the correlation between the different sign systems that constitute culture. Moreover, the systems do not present elements in isolation, but are always immersed in a homogeneous semiotic continuum. In this way the idea of culture explains the necessary notion of dependence and reciprocity between systems in which the necessity of *the other* (another person, another culture) is fundamental. To express it, Lotman coins the term *Semiosphere*:

As an example [...], imagine a museum hall where exhibits from different periods are on display, along with inscriptions in known and unknown languages, and instructions for decoding them; [...] imagine all this as a single mechanism (which in a certain sense it is). This is an image of the Semiosphere. [...] all elements of the Semiosphere are in dynamic, not static, correlations whose terms are constantly changing. (Lotman, 1990, pp.126-127)

Lotman's semiotics differs from the others (Peirce, Eco, Greimas) because, instead of using unity (sign) as a primary element of study, he believes that only a global understanding of the culture system can lead to the recognition of the units that make it up. The smallest functioning mechanism of the process by which an expression takes on the value of a sign, the unity of semiosis, is not a separate element but the entire semiotic space of the culture in question. In particular a specific culture (e.g. the Italian culture of teaching-learning mathematics, in our case) is a semiosphere that lives immersed in the global "all cultures" semiosphere and it can exist as a system only in relation to the cultures with which it continuously exchanges cultural elements: In this sense "it seethes like the sun" (Lotman, 1990, p.150). The internal translation (in its semiotic meaning) currents express the *asymmetric character* of the Semiosphere. In fact, "besides the structurally organized language, [the semiosphere] is crowded with partial languages [semiotically asymmetrical – i.e. without mutual semiotic correspondences with the previous], [...] which can be bearers of semiosis if they are included in the semiotic context" (Lotman, 1990, p.127-128). Asymmetry between languages engenders the *dialogue*. In fact, the whole for Lotman consists of at least two texts, which dialogue with each other thanks to their constitutive asymmetry.

In potential continuity (to be further elaborated – see Discussion) with Chevallard’s systemic-institutional approach, Lotman’s Semiosphere might be considered as a dynamic (never motionless, always bubbling and exchanging) integration (considering also the semiotic and, more generally, cultural aspects) of noosphere.

METHODOLOGY AND DATA COLLECTION

A first experimental activity of LS cycles in a primary school near Turin was carried out starting from the LS experiences conducted in Reggio Emilia (Bartolini Bussi & Ramploud, 2018).

The working group is made up of six people: the researcher (Carola, a PhD student), a retired former teacher-researcher (Ezio) and four teachers who teach in different primary school classes of the same institute. Three are 1st-grade teachers: Michela is a support teacher for low achievers, Nicoletta teaches Italian in her class, Marcello teaches mathematics, science, history, geography, and English. Valentina, the fourth teacher, teaches mathematics and science in 3rd grade. The Italian school system is characterized by high flexibility in teaching in primary school. Teachers teach several subjects and even the support teacher, supporting the class in which there is the low achiever, can take charge of teaching subjects to the whole class, according to his skills, if the team deems it appropriate.

The first part of the experiment consists of three complete cycles in the three 1st-grade classes. The topic of the lesson is the introduction of the “plus” sign for the addition and its institutionalization. The specific goal for children is to understand the concept of addition as the sum of two quantities in its meaning of “putting together” and relate it to the signs of mathematical language. In the second part of the experience, consistently with the previous three cycle, a new lesson is carried out in the 3rd-grade. The designed activity is part of the educational path that includes the knowledge of weight measurements and the study of state transitions, via experiments. The aim is to accompany students in reinvesting their mathematical knowledge and argumentation skills with respect to the transversely of the disciplines. Each teacher implements the lesson in his or her class but in the total co-responsibility of the group, which is there in agreement with the school headmaster. During the lesson, the other participants play the role of active observers: in 1st-grade classes they interact with the students as “hand-lenders”, i.e. they transcribe the thoughts of not yet writing-skilled children.

The experience, covering all four cycles, was carried out from November 2018 to April 2019. For a total duration of 24 hours of group work. All the design (4 hours of initial formation and 8 hours of design de facto, 2 per cycle) and discussion moments (8 hours, 2 per cycle), but also the classroom lessons (1 hour in each class – cycle –, for a total of 4 hours), were video-recorded. Some extracts from these recordings were then transcribed by the researcher. In addition, for each planned lesson, the group produced a Lesson Plan (Bartolini Bussi & Ramploud, 2018): a written document – a table – that collects the entire lesson planning, the objectives the group chose for the lesson, the positioning of the lesson

within the long-term planning of the class, and the educational intentionality behind each choice of the group.

In the next section researcher will present a first analysis of a small transcription excerpt with the Semiosphere. Because of the nature of the Semiosphere, the excerpt is not self-sufficient: other extracts are required to grasp how the elements external to the teachers' and class' semiosphere are gradually translated and understood. Researcher uses the asymmetry within the semiosphere to grasp how teachers' collective practices evolve. Researcher looks at the teachers' discourses - i.e. words and vocabulary used, references to the institutional and cultural aspects of their professional background.

SOME EXCERPTS AND THEIR ANALYSIS

Here is a short extract from the exact beginning of the first meeting of the second LS cycle. Among all the data researcher has chosen to report just this because it represents a turning point for the teachers of the group: They have "now appropriated the methodology, understood its functioning and potential" (in Nicoletta's words, during the review of the first lesson held in her class), but they are still at the beginning of this professional development path. The lesson is still to be revisited and questioned in its details.

Nicoletta has already implemented and discussed the lesson. The LS group are now in the planning phase of the same lesson for Michela's class. Her children, also in Grade 1, have never worked in pairs. The lesson planned for LS includes an argumentation exercise in pairs on a double purchase: The children in a previous class bought a 12 cents card and 8 cents sample clips. Some of them paid with 20 cents. The key question is how and why they paid 20 if the prices tags were 12 and 8. The LS group is reflecting on what changes to make to the lesson for Michela's class. Here they are thinking about an introductory activity to the lesson, to experience the work in pairs for the first time.

Michela: Now I am talking nonsense. *I looked at the tests you did [referring to Ezio], the problem with the balloons:* For example, it could be... [...] you give it to a couple. Because I wanted to rework that one anyway because... I saw it, it is really interesting... also the motivations the students gave. But it could be an idea!

Nicoletta: I believe we could also *do something about the comics* [introduced in the previous design]. [...] The scheme is that one of this reasoning [...] *that you should... that we want to re-propose:* take two reasonings, do what he [Marcello] said [...] That is: what did the children who said "9 plus 6" think before? [...] they are balloons, kids [...] it's too similar with the LS lesson?

Marcello: [shoulders up] in the sense that it is!... in the sense that they *put together*...

In this brief dialogue we already note some essential aspects that can only be understood if we consider the Semiosphere in which the dialogue takes place:

- Tasks reported by a teacher [Ezio] recognized as an expert by the LS group are chosen instead of those reported in the textbook. The teachers had already declared from the beginning that they did not want to rely on the textbook.

To better understand the sphere in which this dialogue arises, researcher also report the following excerpt. Marcello describes his difficulty in relating to textbooks and institutional meta-didactic structures during the group's first planning meeting.

Marcello: [...] maybe you find a very fixed structure: Lessons, notebooks, but if you don't understand... [...] staring at the notebook and “making the notebook” is very far from me, even if it gives you a lot of [confidence]... I mean, I live a lot of anxiety, sometimes I get lost, because if you don't have a structure... but at the same time, I can't really get into it, because I am not interested in doing that. I think the best thing would be to meet [each other]. But of course, the times are what they are [...] I had to write all the subjects I do. Which is a lot. [...] I want to talk to people, I want to see the practices, I want to confront myself directly [...] in my opinion the university is too tied to the book [...] seeing things together gives you a sense.

Using Chevallard we can say that the didactic transposition of some practices is not complete. At least in these teachers' beliefs, such practices have not passed through all the necessary levels of co-determination. There is a gap between academic and implemented knowledge. Lotman, analogously, could tell us that the Semiosphere of the group sees local institutional requests (“making the notebook”) and national ones (mention of university practices) as external elements. They are currently “written” in a language that, Marcello and Michela declare, is not that of the group today. The identification of critical thinking as a practice of semiotic translation allows researchers, but also teachers themselves, to analyze these practices from a semiotic and not only institutional point of view: a semiospherical dialogue is created. The lens of the Semiosphere allows us to perceive the existing asymmetry between the current school reality (many subjects to teach, no time available) and the Italian university culture of prospective teachers, that is a training ground for the first personal beliefs.

- Graphic, material, and gestural visualizations are preferred to only written text: The idea is to propose to the children a drawing with comics and cartoon price tags. Then the group will choose a theatrical performance.

An excerpt from the implementation of the lesson underlines the embodied feature that the group sought to use.

Michela: So, now, kids, let us focus and work on what Valentina did in the sketch. [...] She took a nice moment to think. She looked at the two prices and thought. Did you see Valentina thinking? [...] She thought a little before giving me the coins. Okay? Good! So, I will put these two prices [on the board, so you can see them] ... Now, each of you will have a moment to think to what to say in the couple! Because I am asking you to say what Valentina is thinking right now. Nevi, you must do it in pairs! So, you, your thought will have to share it with Mattia, and Mattia will say his.

Teachers are aware of the Western culture in which they are immersed: Abstract thinking, for an Italian primary school child, must be approached gradually (Mellone, Ramploud, Di Paola, & Martignone, 2019, p.8). Grasping abstract thought requires time and continuity. A theatrical text, using bodily movements, returns the desired continuity: It realizes the act of thinking. Then, translating the action into the graphic text (the comics), the group keeps track of the signs that mark the passage from concrete to abstract.

- The shift of attention from the single teacher – who will enter alone in the classroom – to the co-responsibility of the group is the main objective, and for them the beauty, of this work with the LS methodology. A co-responsibility that is not in the usual Italian teachers' Semiosphere. Nicoletta says: [...] *that you should... that we want to re-propose the following time [...]*. Co-responsibility belongs to LS, but not to the Italian class culture. This asymmetry between the LS Semiosphere and that of the group allows a cultural transposition (Mellone et al., 2019) of the teachers' practices: During all the meetings the teachers bring themselves and their educational intentionality into play. They question their teaching practices with the group. Now educational intentionality and objectives are shared: They are meaningful for each member of the group.
- The exact words of the children are repeated. The expression “put together” was how the children of Nicoletta's class had referred to the idea of sum and therefore it becomes the pivot sign of the LS group for the institutionalization of the + sign.

To discuss this last point more thoroughly, researcher adds here a final excerpt from the implementation of the lesson in Michela's class. A student is responding to the problem posed.

- Student: Valentina thought a little bit about how she made the 20 cents.
Carola: But she has not read 20 anywhere! [...] Was there a 20 written somewhere?
Student: [...] because she puts them together [the two prices on the price tags].
Carola: What is it that she put together?
Student: 20 uh... 12 cents and 8 cents. [...] she counted in her mind... continually.
And she realized that 20, uh... 12 cents and 8 cents make 20.

The task and its implementation guide the children within relational structures, going beyond simple calculation. They look at how the numbers relate to each other. The Semiosphere of the class sees the relational structure still external to itself, but through the pivot sign of “putting together”, it translates its meaning.

DISCUSSION AND CONCLUSIONS

In the previous section researcher tried to observe what happened in the LS experience, through the Semiosphere lens. It is just one of the possible ways to look at a teachers' professional development practice.

Researcher can thus answer the research questions; in fact, it is now explicit that asymmetry is the effective element in analyzing collective teachers' practices. It allows us to read the changes in teachers' daily practices when introducing an element belonging to a different

culture, such as LS. Semiosphere allows to keep together levels of signification culturally distant from each other. However, there is more, it allows to outline the internal structure of our practices: Our Semiosphere. Such a double look helps researcher and teachers to read the transpositions of the knowledge through the levels of co-determination. Here the critical dialogue and reflection of the teachers, if read through the Semiosphere, do not lose contact with the reality in which they are born. So, the problem of possible integration between Lotman and Chevallard lenses according to the Networking of Theories approach (Radford, 2008) arises spontaneously. The analysis of the institutional aspects and the levels of co-determination seems enriched by a dynamic interchange perspective, and vice versa this can be integrated with the institutional constraints typical of a school system governed by laws. Future studies could tell us about the connection of the two theories as lenses for professional development practices.

References

- Bartolini Bussi, M. G., & Martignone, F. (2013). Cultural issues in the communication of research on mathematics education. *For the Learning of Mathematics*, 33(1), 2–8.
- Bartolini Bussi, M. G., & Ramploud, A. (2018). *Il lesson study per la formazione degli insegnanti*. Roma, Italy: Carocci.
- Bosch, M., & Gascón, J. (2006). Twenty-five years of the didactic transposition. *ICMI bulletin*, 58, 51-65.
- Chevallard, Y. (1981). Pourquoi la transposition didactique. *Comunicação no Seminário de Didática e Pedagogia da Matemática IMAG, Publicado no Proceedings*, 167-194.
- Font, V. (2002). Una organización de los programas de investigación en Didáctica de las Matemáticas. *Revista Ema*, 7(2), 127-170.
- Huang, R., Takahashi, A., & da Ponte, J. P. (2019). Theory and Practice of Lesson Study in Mathematics around the World. In *Theory and Practice of Lesson Study in Mathematics* (pp. 3-12). Cham: Springer.
- Hummes, V. B., Font, V., & Breda, A. (2019). Combined use of the lesson study and the criteria of didactical suitability for the development of the reflection on the own practice in the training of mathematics teachers. *Acta Scientiae*, 21(1), 64-82.
- Kim, D. J., Ferrini-Mundy, J., & Sfard, A. (2012). How does language impact the learning of mathematics? Comparison of English and Korean speaking university students' discourses on infinity. *International Journal of Educational Research*, 51, 86-108.
- Lotman, J. (1990). *Universe of the mind. A semiotic theory of culture*. London, United Kingdom: IB Taurus.
- Mellone, M., Ramploud, A., Di Paola, B., & Martignone, F. (2019). Cultural transposition: Italian didactic experiences inspired by Chinese and Russian perspectives on whole number arithmetic. *ZDM*, 51(1), 199-212.
- OECD (2005). Teachers matter: Attracting, developing and retaining effective teachers. *OECD Publishing*.
- Radford, L. (2008). Connecting theories in mathematics education: Challenges and possibilities. *ZDM*, 40(2), 317-327.
- Saxe, G. B. (2014). *Cultural development of mathematical ideas. Papua New Guinea Studies*. New York, United States: Cambridge University Press.