

## Lesson study in the perspective of teacher educators

Adriana Richit<sup>1</sup> 

### ABSTRACT

The paper discusses aspects of the lesson study's implementation in Portugal considering the challenges evidenced in this process and aspects, which attach to this approach particular specificity in the perspective of researchers' teachers, who take up the role of promoters of this approach. Were interviewed four teachers of the Institute of Education, University of Lisbon (*Instituto de Educação da Universidade de Lisboa*), who promote lesson study in Portugal. Our analyze evidenced two aspects about implementation of this approach in the Portuguese context: *aspects relatives to adaptation of this approach in the Portuguese cultural context*, which bring some challenges and request decisions due to characteristics of teaches staffs; and aspects relatives to *specificity of the approach developed in Portugal* with emphasis to exploratory approach, professional collaboration and the realization of micro investigations about professional practice by participant teachers.

### KEYWORDS

lesson study; teacher professional development; initial teacher education; basic education.

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<sup>1</sup>Universidade Federal da Fronteira Sul, Erechim, RS, Brazil.

## ESTUDOS DE AULA NA PERSPECTIVA DE PROFESSORES FORMADORES

### RESUMO

O artigo discute aspectos da dinamização dos estudos de aula em Portugal, considerando-se os desafios manifestados nesse processo e as características que atribuem a essa abordagem especificidade própria na perspectiva de professores-pesquisadores que assumem o papel de seus promotores. Foram entrevistados quatro formadores em estudos de aula do Instituto de Educação da Universidade de Lisboa, que se constituiu no material empírico do estudo. A análise apontou dois aspectos relacionados à implementação do estudo e aula em Portugal: a *adaptação ao contexto cultural português*, que trouxe alguns desafios e solicitou escolhas diante das características dos grupos de professores envolvidos; e a *especificidade desenvolvida em Portugal*, com destaque para a abordagem exploratória, a colaboração profissional e a realização de pequenas investigações sobre a prática profissional dos professores participantes.

### PALAVRAS-CHAVE

estudos de aula; desenvolvimento profissional; formação inicial de professores; ensino básico.

## ESTUDIOS DE LAS CLASES EN PERSPECTIVA DE FORMADORES DE PROFESORES

### RESUMEN

El artículo discute aspectos de la implementación del estudio de clase en Portugal, considerando los desafíos que se manifiestan en este proceso y los aspectos que atribuyen a este enfoque su propia especificidad desde la perspectiva de los docentes investigadores, quienes asumen el papel de promotores de este enfoque. Se entrevistó a cuatro formadores en estudios de clase del Instituto de Educación de la Universidad de Lisboa (*Instituto de Educação da Universidade de Lisboa*), de lo que constituye el material empírico del estudio. Nuestro análisis evidenció dos aspectos sobre la implementación de este enfoque en Portugal: aspectos relacionados con la *adaptación de este enfoque en el contexto cultural portugués*, que presentan algunos desafíos y solicitan decisiones debido a las características del personal docente; y aspectos relacionados con la *especificidad del enfoque desarrollado en Portugal* con énfasis en el enfoque exploratorio, la colaboración profesional y la realización de micro investigaciones sobre la práctica profesional por parte de los docentes participantes.

### PALABRAS CLAVE

estudios de clase; desarrollo profesional; formación inicial del profesorado; educación básica.

## INTRODUCTION

The international research movement on teacher professional development, with emphasis on the possibilities of lesson study, has established relevant understandings concerning this process and indicated distinct aspects underlying this approach due to singularities of the contexts in which they are promoted. These understandings have contributed to implementing lesson study in contexts different from that of Japan, allowing the dissemination and expansion of this approach in other educational environments.

Lesson study originated in Japan and has spread worldwide since the 1990s after Yoshida's research (1999). It consists of a reflexive and collaborative approach to teacher professional development, centered on teaching practice (Ponte *et al.*, 2014). This approach gained prominence in Western countries when it was implemented in the United States, and the results started to be published in English (Stigler and Hiebert, 1999; Yoshida 1999). Thus, lesson study became an object of interest to researchers from different countries, whose experiences have pointed to significant possibilities of adaptation to other educational settings (Stigler and Hiebert, 2016). Within this movement, relevant experiences and research on lesson studies have been carried out in Portugal, producing a knowledge base on the development of lesson study cycles in the Portuguese educational and cultural context.

Therefore, we consider relevant analyzing and discussing the development of lesson study cycles in distinct contexts as a way of pointing out the theoretical perspectives underlying this approach and the singularities of its implementation process that differentiate it from the Japanese approach (Stigler and Hiebert, 2016), evidencing others aspects through research results concerning these experiences. In this regard, we examined the development of lesson study in the Portuguese setting, aiming to identify the specificities of the processes carried out with respect to the adaptation to the country's culture and the educational context to which the teachers belong.

After interviewing researchers and lesson study promoters in Portugal, we found relevant aspects that give the Portuguese approach particular characteristics. These aspects comprise two central themes: the process of adapting lesson study to the Portuguese cultural context and the specificity of the approach carried out in Portugal.

We decided to analyze the lesson study implemented in Portugal due to its proximity (concerning the structure of each cycle and how they are conducted) with the predominant Japanese approaches, as well as particularities evidenced in the process developed in Portugal. These particularities represent significant possibilities to promote teacher professional development, establish lesson study in the Portuguese context, and disseminate it to other Western educational environments.

## LESSON STUDY

Lesson study became an object of interest to researchers and experts in education and mathematics education as research results about this approach started to be published in English. The landmark of lesson study dissemination is the book *The teaching gap* (Stigler and Hiebert, 1999).

However, the development of lesson study outside Japan evidences some adaptations that are necessary to establish this approach in professional and cultural contexts different from those of Japan. Stigler and Hiebert (2016) highlight that educators from different countries have been developing their understandings about how lesson study may be carried out in other settings, aiming to improve the teaching and learning processes in these contexts. Also, White and Lim (2008) argue that distinct circumstances have influenced the structure and development of the Japanese lesson study model, changing aspects in the planning and teaching of the research lesson, as well as in the discussion stage. They conclude that lesson study promoted in the initial and continuing teacher education is strongly influenced by the contexts in which it is carried out due to the needs of formative stages and how teacher education processes are structured. Therefore, the dissemination of lesson study in other environments reveals the possibility of promoting teacher professional development, distinct understandings, and adaptations that give certain approaches special characteristics, contributing to establish knowledge about this process in these contexts.

In this scenario, the research results highlight that lesson study may have distinct goals (Ponte, 2016), take on different forms, and develop according to particular dynamics (Stigler and Hiebert, 2016), considering the different teaching levels and knowledge areas. Furthermore, the goals pursued by a lesson study may vary according to the teacher education method adopted (Ponte, 2016), favoring the development of lesson study cycles in initial and continuing teacher education.

Lesson study development has two prevalent perspectives. In the first perspective, a lesson study cycle is coordinated by a teacher-researcher team, which often belongs to a teacher education institution and takes on the role of developing the process. In the second perspective, predominant in the Japanese educational context, lesson study is designed and carried out by a teacher group of a school institution, without involving an external team that coordinates the process. However, in both perspectives, the lesson study involves a teacher team that collaboratively plans a lesson called research lesson. A team member voluntarily teaches the research lesson, while the other teachers observe the students' actions and take notes.

The lesson study developed in Japan has a common nuclear structure, which is susceptible to adaptations according to its contexts and goals. This framework consists of three stages: research lesson planning, teaching of the research lesson, and discussions about this lesson based on notes taken by teachers who observed the students' actions (Lewis, 2002). Nevertheless, re-

search results reveal that, in several experiences, the lesson study cycle starts by defining the goal of the research lesson, considering the students' difficulties concerning the curricular subject to be taught. Thus, a prevalent model has emerged in experience reports on lesson study carried out throughout the world. Its framework consists of four main stages: definition of research lesson goals, planning, teaching, and discussions about the lesson (Lewis, 2002; White and Lim, 2008; Ponte *et al.*, 2014). However, some reports on lesson study cycles propose a fifth stage, which consists of reviewing, reformulating, and teaching the research lesson again to other students. This fifth stage was named follow-up (Ponte *et al.*, 2014).

In a lesson study, a teacher team collaboratively works on five principal tasks: *definition of research lesson goals* focuses on students' difficulties about the particular curricular subject chosen to be explored in the lesson study; *research lesson planning* has the teachers planning in detail a lesson and its related tasks, considering the difficulties that students may have in that subject, seeking to anticipate issues, reasonings, and resolution strategies for the proposed tasks. In the *teaching of the research lesson*, a teacher participating in the lesson study cycle voluntarily agrees to teach the lesson while the other teachers observe the students' actions. *Discussions about the research lesson* involve team meetings, in which the teachers reflect and discuss on the aspects registered in field notes and video recordings of students' actions, debates, and conclusions when performing tasks. *Follow-up* proposes reformulating the lesson based on aspects highlighted in the discussion session, and, if desired, this lesson may be taught again to other students (Ponte *et al.*, 2014).

With respect to the lesson study nature, which gives this process very specific characteristics and dynamic, research results have revealed distinct aspects, such as collaboration, pedagogical approach underlying the research lesson, development of studies on teaching and learning processes related to research lesson.

Collaboration, conceived as a particular way of cooperation that permeates a work group and allows the participants to deepen their knowledge mutually (Day, 1999), is increasingly highlighted in investigations on lesson study because it supports the work of teachers participating in all stages of the process, especially the planning and teaching of the research lesson (Takahashi and MacDougal, 2018). According to Boavida and Ponte (2002), in a collaborative context, teachers work together and cooperatively in equal conditions, with trust and mutual assistance leading them to achieve goals that benefit all participants. The authors complement that collaboration is developed among peers, within groups that work toward a shared project, or among people who assume distinct roles, such as teachers and students, teachers and researchers, etc. The diversity of a group results from the goals of the work to be performed. Furthermore, they consider that despite the difficulties that may arise in these groups, the advantage of having different perspectives on the same reality prevails, favoring broader and deeper understandings (Boavida and Ponte, 2002).

Collaboration involves cooperation, trust, mutual assistance, communication, negotiation, and overcoming hierarchies. According to Day (1999), the difference between collaboration and cooperation relates to how personal and power relationships develop. In cooperative groups, power relationships and the participants' roles are not questioned. On the other hand, the collaborative relationship presupposes careful negotiation, joint decision making, effective communication, and mutual learning in a project that focuses on the promotion of professional dialog (Day, 1999).

Goulet and Aubichon (1997) underline that the first step toward collaboration is trust, which is developed in a context of care and respect, at personal and professional levels. Trust is fundamental for team members to feel comfortable to expose their ideas and queries, as well as question the ideas, values, and actions of colleagues, respecting and appreciating them, while their work and values are respected and appreciated. Therefore, without trust, there is no collaboration (Boavida and Ponte, 2002).

Communication is also essential to achieve collaboration. Olson (1997) points out that a collaborative relationship requires accepting the personal voice that results from experience and the awareness that no idea is definitive because, as a voice intertwines with other voices, the understanding becomes richer and the conversation, more informed. Consequently, communication is a device for confronting ideas and building new understandings (Christiansen, 1999).

In addition, collaboration involves negotiation because, in a collaborative group, the goals, work and relationship forms, priorities, and meanings of fundamental concepts are negotiated (Boavida and Ponte, 2002). Regarding this aspect, Christiansen *et al.* (1997, p. 285) state that “the key to a successful collaboration is an open negotiation over power-sharing and expectations related to the role of each participant as the project is developed”.

By emphasizing the collaborative dimension of each stage of the lesson study, Takahashi and MacDougal (2018) describe the collaborative research lesson as an opportunity to improve teaching and learning, as it allows teachers and education professionals to participate in, discuss, and reflect on the lesson study cycle, together with the team involved in its implementation. Besides, the results of professional learning may be shared in the school environment with seminars for the community. Moreover, the dynamics of lesson study favor the overcoming of teaching points of view and difficulties, as the relationship of trust and mutual support allows teachers to rethink their practices (Ponte *et al.*, 2014).

Another relevant aspect of lesson study is the pedagogical approach underlying the research lesson. A perspective highlighted in studies carried out worldwide is structured problem-solving, which is central to Japanese lesson study approaches. Fujii (2018) emphasizes that problem-solving in the Japanese lesson study is widely valued and disseminated, although some of its aspects can have higher or lower importance.

The exploratory approach, which is similar to structured problem-solving, has been increasingly described in lesson study reports. Ponte *et al.* (2014) highlight that the exploratory approach in mathematics teaching allows the teacher to reflect on classroom lessons while trying to lead the students to face unforeseen situations for which they have no ready solution method (Ponte, 2005). This approach drives the students to construct or deepen their understandings of mathematical concepts, representations, procedures, and ideas.

Exploratory approach, also known as inquiry-based approach, involves the process through which the students are invited to have an active role in interpreting proposed tasks/activities, representing the information provided, formulating generalizations, and planning and implementing resolution strategies, which they must know how to present and justify (Ponte, 2005). In exploratory teaching, the students can see the “mathematical knowledge and procedures emerge with meaning and simultaneously develop mathematical abilities such as problem-solving, mathematical reasoning, and mathematical communication” (Canavarro, 2011, p. 11).

In previous research, Ruthven (1989) explains some aspects that differentiate the exploratory approach from traditional educational ones, indicating that, in this approach, the teachers’ role is aimed *at* and focused *on* the investigation performed by students. Also, in the exploratory approach, new ideas and concepts are introduced by two stages wherein exploration (a form of investigation) is followed by codification (a form of exposition). Ruthven adds that, in the exploration stage, students perform an investigation of open situations.

Concerning the development of investigations on teaching, Stigler and Hiebert (2016) underline that a lesson study approach adopted outside Japan takes on a research methodology perspective. According to this perspective, the research lesson, conceived as an analysis unit, is small enough to be explored and big enough to represent key components of a teaching and learning system. The authors complement that classroom research is a way of introducing a scientific research practice to the classroom environment (Stigler and Hiebert, 2009).

Similarly, Cochran-Smith and Lytle (1999, p. 321) refer to the research on their own practice as a teachers’ “systematic and intentional inquiry about practice,” in which “systematic” comprises records and documents of classroom internal and external experiences. “Intentional” indicates a teacher’s professional activity naturally imbued with purpose. This knowledge is dynamically (actively) constituted, integrating theory and practice and promoting the movement between the singular of each teacher and the plural of the teacher community who investigate their own practice.

According to Ponte (2018), lesson study is also an opportunity for teachers to carry out a small investigation about teaching in the classroom and, consequently, about professional practice. Namely, each teacher group engaged in lesson study comprises a small collective who develops research on their own practice (Ponte, 2008), and whose investigation begins with the formulation of an investigation question related to the students’ learning

difficulties in a given curricular subject. By combining practice knowledge and research knowledge, teachers can experiment with a professional development model with high potential to promote professional learning related to student learnings, curriculum interpretation, and their own practice (Ponte, 2018; Ponte *et al.*, 2016).

Therefore, according to Stigler and Hiebert (2016), the possibility of the teacher making choices and the actual choosing process observed in lesson study are perhaps the main advantages of adapting original cultural routines to distinct contexts.

## METHODOLOGY

This interpretive qualitative research consists of a content analysis (Bardin, 1977) of empirical material collected from semi-structured interviews conducted with four Portuguese researchers, who developed lesson study cycles and investigated this approach in the mathematics and sciences areas, specifically physics and chemistry. The study involved João Pedro da Ponte, Marisa Quaresma, Mónica Baptista, and Teresa Conceição, as these researchers were the main disseminators of this approach in Portugal and have greater experience and participation in lesson study in that country.

The semi-structured interview, regarded as a relatively guided process from which the researcher aims to understand a specific phenomenon deeply and broadly (Triviños, 1987), was based on three aspects: the lesson study experiences developed in Portugal, challenges and difficulties experienced during the lesson study implementation process, and especially the research contributions to consolidate the knowledge about this approach for the professional development of mathematics and sciences teachers.

Teachers were interviewed in March, April, and May 2017. The interviews were transcribed, converted into text, and sent to the research participants (developers of lesson study in Portugal) to validate the empirical material. Next, the empirical material was analyzed based on two guiding questions: What are the experiences in lesson study developed in Portugal and how these processes were carried out? What are the specificities of lesson study cycles concerning the pedagogical approach underlying the research lesson and the other process stages?

The analysis revealed distinct aspects related to the experiences and research on lesson study developed in Portugal. These aspects were organized in two themes: particularities of each lesson study cycle when it comes to *adapting the lesson study to the Portuguese cultural context* and the *specificities of the approach developed in Portugal*, highlighting the exploratory approach, the professional collaboration, and the performance of micro-investigations by the participating teachers on their own practice.



## PROMOTION OF LESSON STUDY IN PORTUGAL

The development of lesson study cycles in Portugal started in 2011, when the teachers participating in this research had contact with this teacher professional development method and felt motivated to implement it in their country. With the demand for teacher education actions in the Portuguese public education system and after a discussion between teacher-researchers of the Institute of Education of the University of Lisbon (*Instituto de Educação da Universidade de Lisboa*), a teacher team was formed to design the first lesson study to be developed during the 2012–2013 school year. This experience involved elementary school teachers. After this first experience, other lesson study cycles were developed for the initial and continuing education of mathematics and sciences teachers, specifically physics and chemistry.

In mathematics, lesson study cycles were developed for the continuing education of elementary school teachers (1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> cycles) as well as initial teacher education, specifically for the master's in teaching of the Universidade de Lisboa, in which the topics “angle concept”, “proportionality”, and “rational numbers” were studied. In sciences, specifically in physics and chemistry, lesson study cycles were developed for the continuing education of 3<sup>rd</sup>-cycle elementary school teachers, as well as for the master's in teaching of the Universidade de Lisboa, in which the topics “speed of sound”, “kinetic energy” and “impulse” were explored. The lesson study promoted in initial teacher education was implemented in the Professional Practice Initiation (*Iniciação à Prática Profissional* — IPP) discipline and involved a university-school partnership. This activity favored the integration between university teacher education experiences and professional classroom practice, considering the particularities of that educational context.

Outcomes of the research developed by the participating teachers point out the contributions of lesson study to student learning.<sup>1</sup> According to these results, the exploratory approach underlying the research lesson led students to develop mathematical reasoning as they had the opportunity of exploring different representations, as well as formulating justifications and generalizations concerning the curricular subjects studied (Ponte *et al.*, 2015; Quaresma and Ponte, 2015).

Therefore, the lesson study developed in Portugal reveals distinct aspects related to this approach, mainly regarding the lesson study dynamics, given the particularities of the Portuguese professional and cultural contexts. These aspects convey the challenges and difficulties arising from lesson study adaptation to the culture and reality of Portugal and the specificities of the approach developed.

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1 Researches concerning to students' mathematical learning achieved in lesson study context has been presented in works published by the collaborators of this investigation, namely: João Pedro da Ponte, Mónica Baptista, Marisa Quaresma, and Teresa Conceição. In this analysis, we do not consider this aspect because it escapes the objective of the text. We emphasize, however, that this is a theme that is not frequently presented in research on lesson study in Brazil.

## LESSON STUDY ADAPTATION TO THE PORTUGUESE CULTURE AND EDUCATIONAL CONTEXT

Regarding the singularities of the lesson study cycles carried out in Portugal, both in continuing and initial teacher education, the teachers participating in our research highlight that this process initially required a deep understanding of the approach originally performed in Japan and other settings that promoted lesson study, as well as an analysis of the cultural specificities and needs of the Portuguese education context. According to Marisa:

[Initially], it is necessary to investigate the need or cultural characteristics [of our context] while studying the teacher professional development process that was tested in other countries: the original lesson study, how it is performed in Japan, how it is performed in Asia, how it is performed in the United States (which has a strong influence on the lesson study carried out in Western countries), and then how it has been performed in Europe. Therefore, the adaptation of lesson study to our culture has been our biggest challenge because this process has revealed several obstacles. (Marisa, Apr. 2017)

Given the specificities of the cultural context and of the lesson study process, adapting the original model performed in Japan is necessary. Marisa underlines that, in the lesson study carried out in the IPP discipline from the Master's in Mathematics Teaching, the choice of which curricular subject to study was restricted to the themes investigated by the cooperating teacher in the IPP class.

We were limited to the topics that the teacher had [to develop in that class]. We did not have many options to choose the themes according to our interests [...] in terms of topics and themes studied. (Marisa, Apr. 2017)

Another aspect highlighted by the teachers is the specificities of implementing lesson study in the initial and continuing teacher education. João Pedro explains that, although the lesson study development dynamic is similar in both processes, the goals and professional learning are distinct because the needs of teachers and future teachers are different.

Regarding future and in-service teachers, we have developed a similar dynamic, but public teachers are different, and so are the goals. Future teachers have no teaching experience; therefore, they are in a stage of professional learning different from that of in-service teachers. And this is taken into account in the planning stage and also in the role assumed by participants in lesson study. This emphasizes the need for paying attention to several aspects that must be handled during the sessions because the lesson study

with future teachers aims to support professional learning different from those pursued by in-service teachers. (João Pedro, May 2017)

Mónica states that the way initial teacher education of the master's in teaching (Instituto de Educação) is structured and the cultural characteristics of the educative system led to distinct lesson study models in initial and continuing teacher education.

I would say that the difference between initial teacher education and continuing teacher education is specifically in the planning stage because [in initial teacher education] we had more planning sessions and discussed more research results with future teachers. In this aspect, future teachers were better prepared. They had the opportunity to read and discuss papers, know what the authors say, etc. Resistance is more common in continuing teacher education. (Mónica, May 2017)

João Pedro and Mónica presented relevant aspects: in initial teacher education, future teachers are more available to participate in lesson study and perform academic activities (readings and discussions of research results); in continuing teacher education, the teachers might develop professional learning because they have an established professional experience.

Furthermore, the participating teachers highlight that the adaptation of lesson study to the culture of Portugal faced some challenges. One of these challenges is the existence of teacher groups willing to participate in lesson study. According to João Pedro and Marisa, this challenge often arises from teachers not knowing the approach.

[...] the first challenge, the first issue is finding a teacher group interested in developing the lesson study [...] because people don't know what lesson study is, they don't know what it is, and when they receive an explanation, they think it is strange because it's an approach they've never seen. [...]. Another problem concerns the focus of lesson study, that is, instead of exploring just one topic, why not study multiple topics? Teachers also find it odd to have many observers watching a lesson and one teacher being watched [...]. These characteristics lead to some difficulties in having wide acceptance to initiate a lesson study. (João Pedro, May 2017)

The first major obstacle we had was the acceptance of a new method, which people do not know. Teachers, many of them are very experienced and are used to that traditional teacher education model based on conferences or lectures, in which they go to sessions and listen to the educator say what the best practices in research and teacher education are. (Marisa, Apr. 2017)

João Pedro and Marisa emphasize the teachers' resistance in accepting a different teacher education approach that, at first glance, seems strange. With

respect to lesson study specificities, Marisa adds the challenge of forming a collaborative group because collaboration is not part of the teacher's routine:

Afterward, we had difficulty in assembling the groups. In the first session, we realized that teachers were not used to working together, in groups; thus, they did not constitute a collaborative group, there was no work dynamic among them, nor enough closeness for people to feel comfortable talking. (Marisa, Apr. 2017)

Therefore, regarding the lesson study adaptation to the Portuguese educational and cultural context, the participating teachers stress that this process requires deeply knowing the approach, its assumptions, and dynamic, as well as the particularities and needs of the context in which this approach will be developed, aiming to overcome the challenges that arise in this process, especially those concerning the acceptance of lesson study and the feasibility of its dynamization. Besides, as the reality in which the lesson study will be developed becomes known, it is possible to create the conditions for its implementation. This aspect demonstrates that the development of this approach in other contexts is prone to challenges, which often lead to some adaptations.

## SPECIFICITIES OF THE LESSON STUDY APPROACH DEVELOPED IN PORTUGAL

The statements reveal three central aspects concerning the lesson study practiced in Portugal: exploratory approach, development of micro-investigations on professional practice, and collaboration achievement.

The exploratory approach was highlighted as the main characteristic of the lesson study implemented, supporting the research lesson planning, the nature of the proposed tasks for this lesson, and especially the practice of professional who teaches the lesson and promotes a collective discussion in the classroom:

We adopt a perspective that values some dimensions [of lesson study], namely, the mathematics didactic dimensions [...] that include the selection of the tasks on which teachers will work, the way of organizing the classroom, and the teaching approach. We value the exploratory approach, how the teacher carries out the classroom practice, the kind of communication, including collective discussions. (João Pedro, May 2017)

The exploratory approach is also mentioned by Marisa when she explains that this perspective has supported many teacher education processes in Portugal and particularly influenced the lesson study experiences they carried out:

In Portugal, we have a particular characteristic that is part of our lesson study design, which refers to the exploratory approach. Essentially, all our

teacher education processes, all our teacher education devices are developed from a common base that is the exploratory approach [...]. Therefore, using tasks, essentially, everything is linked to the exploratory approach, isn't it? Using more open tasks allows the teacher to promote collective discussions in the classroom and consequently develop the students' mathematical reasoning. Therefore, all this, this triad is always at the base of our teacher education processes. (Marisa, Apr. 2017)

In the context of the described experiences, the exploratory approach surpassed the research lesson boundaries by involving mainly teachers and permeating the stages of research lesson planning. Furthermore, the exploratory approach emerged in discussions among the participating teachers about tasks to be proposed for the students and in the process of deepening the curricular subjects explored in each lesson study cycle:

The development of knowledge about the task nature, the difference between problems, exercises, investigation tasks, and explorations is always at the base of our practice [with the teachers] because it is something that our community needs to handle, about what are these distinct tasks, how can they be used and managed [...]. Therefore, we were always very concerned with this approach of the tasks, of communication. [...] of communication in the classroom, [...] collective discussions. (Marisa, Apr. 2017)

As a result, the exploratory approach, in a broader spectrum, marked the dynamics of the reported lesson study, standing out in several stages, but mainly supporting the process of deepening the curricular subject experienced by teachers, in which concepts were discussed and meanings, negotiated among peers. Exploratory approach permeated the research lesson, with the proposed tasks and the teacher intervention favoring the collective discussion, the communication of the students' mathematical ideas, the formulation and verification of conjectures, and the drawing of conclusions.

Another aspect present in the statements pertains to the fact that the lesson study represents a context in which the participating teachers develop investigations on the practice, especially concerning student learning. João Pedro details this process:

[An aspect which] seems we are inaugurating is the fact that lesson study constitutes an investigation of professional practice carried out in a structured way, proposing an initial question, which is the starting point of the work. The next stage is preparing an experience in which teachers study different aspects, and from that, they document the tasks that can be proposed to the students, the difficulties the students may have in exploring that topic, and the influences of curriculum guidelines. This corresponds to the preparation and study that is done in an investigation, based on lite-

ature review and conceptualization. Afterward, we have the research lesson, which works somewhat as an experiment in which a given conjecture on how to promote student learning is put into practice. This is carried out in a lesson, in which data are collected. Then, these data are analyzed, followed by a discussion and a reflection. Therefore, this activity corresponds to a micro-investigation carried out by those teachers and focused on their professional practice. (João Pedro, May 2017)

Mónica and Teresa explain how this aspect is handled in the initial teacher education, emphasizing the moments of deepening theoretical and content knowledge, followed by the thorough preparation of the topic of the research lesson.

After analyzing the students' difficulties, we have a moment dedicated to studying what has been produced in research concerning the curricular topic. And we have another component that is elaborating a diagnostic task, which is carried out in the classroom. Then, the next stage is preparing the lesson focusing on that topic. These planning sessions involve five or six meetings of two hours and thirty minutes each. The last step consists of reflecting on this process, with teachers telling us what they have learned. (Mónica, May 2017)

I would say that lesson study is an intense and very detailed work [...]. This work involved analyzing the curriculum, deepening the curricular subject, analyzing scientific papers on the students' conceptions about that topic, preparing tasks to be solved by future teachers, and selecting texts suitable to the initial teacher education program and applicable to lesson study. This introductory work is essential for the discussions carried out during the sessions to be productive and useful for future teachers. (Teresa, Mar. 2017)

In addition, the participating teachers had the opportunity of disseminating what they have observed and learned at a national conference, an event that provided them with different learning and reflections on the experience:

Also, this 3<sup>rd</sup> cycle school, at that national conference related to the project, we saved some time for this part of the lesson study experiences. It was very positive a moment. (Mónica, May 2017)

Teachers had to systematize their experiences to disseminate what they learned in lesson study and in the micro-investigations on their practice. Moreover, they had the opportunity of reflecting with their peers about these experiences, expanding discussions, and contributing to promoting lesson study to other teachers.

Therefore, lesson study constitutes a context for teachers to carry out micro-investigations on their professional practice. This experience has allowed them to acquire professional learning on curricular subjects and aspects that influence their teaching, specifically the research outcomes and national guidelines, as well as contributed to their professional development. In contrast, this experience has influenced the lesson study dynamic, revealing unsuitable stages and situations or aspects that need changes. Besides, the experience affects the teacher professional practice when they feel motivated and willing to modify it.

Regarding *professional collaboration*, which is one of the main characteristics of lesson study, we found that this component took on an important role in the experiences developed in Portugal. First, the Portuguese experiences involved the negotiation of conditions to enable the development of lesson study with education managers. Next, professional collaboration permeated all lesson study stages, as well as personal and professional relationships among those participating and involved in lesson study, and especially contributed to suppressing some hierarchies linked to the different roles assumed by teachers in schools and the lesson study cycle.

According to João Pedro, the first aspect refers to the collaborative nature of lesson study, which initially influenced the relationships among participating teachers and professors who carry out the lesson study:

Lesson study is a strongly collaborative process. Therefore, every lesson study, from beginning to end, is carried out in a collaborative environment, establishing a collaborative relationship among participants and promoters. (João Pedro, May 2017)

Marisa clarifies the distinct levels of collaboration that marked the lesson study experiences in which she was involved, and stresses the need to overcome some differences concerning the responsibilities and roles assumed by teachers so as to establish a trust level that favors the involvement of all parties.

Collaboration [involves] several levels. We are talking about a collaboration level that is not possible when the university intervenes, [that is] all group members must have an equal level of responsibility and participation. When we have a group from the university, this group naturally has an extra responsibility [...]. Therefore, there is no recipe, but we must have trust [because] without this trust for people to expose their doubts and problems and to want to participate in the discussion, I believe that there can be no involvement. So, teachers' voluntary participation in lesson study is a crucial factor for the successful development of this work. (Marisa, Apr. 2017)

Marisa stressed the plurality of a collaborative group as an aspect that favors collective growth; however, she emphasizes that differences are

overcome only by establishing a trust level among all members. Teresa reinforces this aspect by underlining the collaborative nature of lesson study and pointing out the possibility of overcoming individualism in teacher professional practices when decisions are negotiated in the group and actions are collectively performed, sharing responsibilities and based on communication, on an equal footing.

In the lesson study, the whole process is collaborative, done together, that is, there is receptivity for a broad discussion of different points of view, valuing the sharing and construction of new ideas. [In the] experience we had, we faced some challenges. Teachers are used to working alone and have strong and personal teaching perspectives, which must be negotiated during lesson study sessions. This is accomplished through the negotiation of ideas. Sometimes, an agreement is reached; sometimes, it is not. In the end, an idea stands out, which must be the result of sharing ideas and building others. (Teresa, Mar. 2017)

Teresa emphasizes that the negotiation process underlying the lesson study cycles was essential to overcome professional individualism:

In collaborative work, the way of handling the curricular subject with students is not decided by one teacher; it is what the group understood as the most appropriate. And the same criterion is applied to the materials used by students in the classroom. Effectively, everything that is developed in a lesson study results from decisions made together. And, therefore, the lesson planning, the way of working with the students, and the materials used in the classroom, all these aspects were discussed by everyone. I think this is a big change in the way teachers work, especially if we take into account that their work is usually individual. And that was one of the main challenges. (Teresa, Marc. 2017)

Deepening the strong aspects of lesson study, Mónica points out that collaboration among members involved in the process presupposes teacher motivation and especially the collaboration of school managers, taking collaboration to a distinct level, which also includes school managers and school groups.

I think that the school's intentions or school management's intentions are different from teachers' intentions. There is no doubt that teachers need to be involved because if they are not motivated to participate in lesson study, if they face problems with school timetable or if the school management is not able to create conditions for [teachers to participate in lesson study, this] will not work. And what we saw [was that all teachers were very involved]! (Mónica, May 2017)



Mónica illustrates this aspect by giving an example of a school, in which teachers had time in their workload to develop the lesson study activities: “In this school [...], the principal set time in the [school] timetable for the mathematics teachers to work together. Another dimension of collaboration achieved in the lesson study developed in Portugal is the possibility of transposing some hierarchies:

Still on teacher collaboration, there is another aspect, which involves hierarchy issues, even though they are all in-service teachers. Therefore, when there is no natural leader, which was the case in our lesson study, and a teacher is willing to lead without being recognized by everyone, situations are created that are not favorable to the development of collaborative work. From the moment the leader was accepted, the process ran more smoothly, with less friction. [These issues] were overcome, but they existed, and I think they were felt by everyone. But, I can say that everyone was able to deal with this situation. But, the leader actually had to assert himself. (Teresa, Mar. 2017)

Similarly, in lesson study cycles performed in initial teacher education, particularly in the IPP disciplines, this aspect was essential for the process and contributed to the learning of future teachers:

During the sessions, we tried to make the [future teachers] feel part of the group. In all sessions, they were encouraged to present their ideas and discuss and criticize their colleagues’ and teachers’ ideas. Future teachers’ ideas were much valued and taken into account by us. We tried to mitigate professional hierarchies [...]. We tried to allow future teachers to perform roles equivalent to those of cooperating teachers [...]. It was intentional to mitigate hierarchies and strengthen trust during sessions. There were no hierarchies. That’s what we aimed for. (Teresa, Mar. 2017)

Therefore, regarding the lesson study cycles performed in initial teacher education — in mathematics as well as physics and chemistry —, we highlight that this process was characterized by a distinct aspect, which led to a positive result. This aspect was the participation of a cooperating teacher, who is a permanent teacher of a specific school and teaches specific school years, in which the future teachers could develop their IPP activities, including the supervised internship. The participation of this professional took the collaboration in personal and professional relationships to another level, involving everyone in a co-participated teacher education process. Finally, the collaboration included people with different roles and motivations, in a relationship marked by communication, negotiation, trust, and overcoming of hierarchies, favoring the professional growth of all parties.

## DISCUSSION

Regarding *lesson study adaptation to the Portuguese culture and educational context*, our research reveals the prevalence of the model structured in four stages — definition of lesson goals, planning, teaching of the research lesson, and, lastly, discussions on this lesson (Lewis, 2002; Stigler and Hiebert, 2009; White and Lim, 2008). Occasionally, this lesson is reviewed, reformulated, and taught again to another class, especially in lesson study cycles promoted in the IPP. In continuing teacher education, when recommended, this step (follow-up) is often carried out only by the teacher team that participates in the lesson study, that is, without the coordination of the professor team.

Concerning the dynamic of lesson study cycles performed in Portugal, our analysis stresses the predominance of processes coordinated by an external team of professors (Ponte *et al.*, 2016). All experiences reported had a team that took on the task of coordinating the cycle, differentiating this approach from the Japanese one. In Japanese lesson study, a cycle is carried out by organically active groups organized inside a school or belonging to distinct schools, dispensing with the figure of an external agent to coordinate the process.

Furthermore, our research shows that lesson study adaptation to the Portuguese context requires some small modifications in its stages (White and Lim, 2008), specifically regarding the number of planning sessions for each cycle and the meeting dynamic. These specificities were influenced by the goals of each lesson study cycle performed and by the formative processes included — initial or continuing teacher education (Ponte, 2016) —, leading to very particular lesson study cycles (Stigler and Hiebert, 2016).

Another aspect observed in the Portuguese experience refers to the existence of contexts favorable to the development of new formative approaches, as occurred in lesson study. Portugal has a culture of collaboration among distinct educational sectors and agencies so that proposals of formative actions can originate from teachers and school groups, researchers and teacher education institutions, or even be an initiative of education managers or funding agencies. This culture contributes to providing the necessary conditions to develop lesson study cycles in that education system.

Regarding lesson study adaptation to the Portuguese educational and cultural context, a process influenced by the specificities and needs of the environments in which it was implemented (White and Lim, 2008), our analysis indicated the need to investigate lesson study and context. This process requires deeply knowing the approach, its assumptions, and its dynamics, as well as the particularities and needs of the context in which lesson study will be developed, aiming to overcome the challenges that arise in this process, especially those concerning the acceptance of lesson study and the feasibility of its dynamization by creating the necessary conditions for its implementation.

With respect to the *specificities of the lesson study dynamic*, namely the exploratory approach, the development of micro-investigations on classroom teaching, and professional collaboration, our analysis highlights that these aspects have become

central, characterizing the approach promoted in Portugal. The exploratory approach allowed teachers and future teachers to reflect on classroom teaching, while leading students to face situations for which they have no ready solution method (Ponte, 2005; Ponte *et al.*, 2014), such as exploratory tasks. As a result, they had to work together to solve these tasks (Fujii, 2018), proposing and discussing solution strategies and communicating their mathematical ideas. Besides, teachers and future teachers faced the challenge of studying and developing open mathematical tasks, which did not have pre-defined solution methods, experiencing the exploratory approach in their formative process. This aspect led them to build or deepen their understanding of concepts, representations, procedures, and ideas about curricular subjects covered in lesson study cycles.

The exploratory approach also supported a collective discussion in the classroom, during the research lesson, as the teacher stimulated comparisons of and discussions on the students' solutions, and summarized their conclusions (Fujii, 2018). In this regard, both students in the research lesson and teachers and future teachers in planning sessions were encouraged to participate and investigate the exploratory tasks. These tasks contributed to deepening the curricular subjects addressed in the lesson study by requiring that ideas, conjectures, conclusions, and generalization be discussed and systematized during the collective discussion (Canavarro, 2011). During the research lesson planning, the exploratory approach was implemented through exploration, conceived as a form of investigation, and codification, defined as a form of exposition (Ruthven, 1989), since teachers and future teachers needed to explore and understand the concepts and properties that would be addressed in the exploratory tasks. Subsequently, they created coherent tasks (open situations), covering these concepts and properties and considering the students' difficulties.

As to the *development of micro-investigations on teaching* involving the research lesson, the present study showed that this lesson constituted an analysis unit, which represented the teaching and learning processes in this stage (Stigler and Hiebert, 2009, 2016). The research lesson planning allowed teachers to develop knowledge about classroom teaching, mainly related to didactics. This knowledge is produced by a continuous meta-analytical posture, questioning of professional practice, ongoing interpretation, and constant feedback (Roldão, 2005).

The investigation started with the formulation of a research question (Ponte, 2008) related to student learning (definition of research lesson goals). It involved deepening the theoretical knowledge on student learning, study on research results, studies on the curriculum, and detailed preparation of the research lesson topic. The research lesson, in turn, represented a collaboratively oriented and developed practice and an environment for professional knowledge growth among peers. This knowledge was incorporated into practice (the research lesson), giving it new meanings. It was also reviewed and deepened in the post-lesson reflection stage with a thorough and deep discussion with peers and/or supervisors, allowing teachers to acquire new professional learning. Finally, in some lesson study cycles performed in Portugal, the knowledge produced in this process started to support the professional practice (in the follow-up stage), which was investigated and discussed again with peers.

*Professional collaboration*, which involved aspects such as cooperation, trust, mutual assistance, communication, and hierarchy suppression, was achieved with the joint development of lesson study stages, allowing teachers to deepen their knowledge together (Day, 1999), benefiting all parties — teachers, future teachers, lesson study promoters, cooperating teachers, school managers — with some level of professional growth.

A collaboration aspect highlighted in our analysis is trust, which was developed from respect and attention to the needs and interests of all members involved in the process, encompassing personal and professional levels (Goulet and Aubichon, 1997). Trust is an essential condition for the teachers involved in lesson study to feel comfortable in exposing their ideas and questions (Boavida and Ponte, 2002), deepening their knowledge about some topic, implementing a new curriculum program (Ponte *et al.*, 2014), and discussing and reflecting on their classroom practice. The analysis shows that trust was crucial for the participants' learning both in initial and continuing teacher education because it promoted the involvement of all parties, as they were encouraged to participate and felt part of the process.

Besides, lesson study in the Portuguese context involved negotiating goals, work and relationship forms, priorities, and meanings of fundamental concepts (Boavida and Ponte, 2002), which are central elements in this professional development approach and determinant for the feasibility of lesson study. The negotiation that took place in the process influenced the sharing of power and expectations regarding the hierarchies and roles assumed by the different subjects involved in lesson study (Christiansen *et al.*, 1997), as the whole process was carefully negotiated. Lesson study, both in initial and continuing teacher education, involved a broad negotiation process, which started by making the process feasible with the education managers in Portugal. The next stage consisted of a careful negotiation between the teachers participating in lesson study and school managers, culminating in the conditions necessary for each lesson study cycle to be carried out.

Similarly, communication helped to achieve collaboration because it demanded the acceptance of each person's voice, resulting from experience, and the awareness that no idea or choice is definite (Olson, 1997), becoming an instrument for confronting ideas and building new understandings (Christiansen, 1999). The analysis shows that, in the process of stimulating lesson study, everything was thoroughly and collectively discussed. Also, trust and communication made it possible to suppress some hierarchies and roles assumed in those teacher groups. Finally, it allowed teachers to overcome individualism in their professional practices, as the decisions were negotiated by the group, and the actions were carried out collectively, sharing responsibilities and based on communication, on an equal footing.

Therefore, the research reveals that, in the lesson study context, teachers worked together and cooperatively on an equal basis, and that trust and mutual assistance led them to achieve goals that benefited all parties (Boav-

ida and Ponte, 2002), namely, professional learning. Regarding the lesson study cycles promoted in the initial teacher education, the participation of the cooperating teacher took the collaboration in personal and professional relationships to another level, involving everyone in a co-participated teacher education process.

## CONCLUSIONS

The research shows that lesson study can be promoted outside Japan as long as cultural characteristics are taken into account and carefully used as a basis to plan, implement, evaluate, reformulate, and reimplement the entire process. Lesson study adaptation in Portugal required understanding both the original Japanese approach and the Portuguese educational reality as a way to overcome the inherent challenges of the process. These aspects contributed to creating the conditions necessary for each lesson study, demonstrating how the adaptation of this approach offered new possibilities to promote teacher professional development in Portugal.

Furthermore, our study helped to consolidate some understandings about teacher professional development, whose foundations comprise aspects related to the exploratory approach, the assumption of a perspective of investigation performed by teachers on their professional practice, and collaboration achievement in distinct levels and dimensions. Exploratory approach permeated the teacher education process through lesson study, as teachers engaged in an exploratory approach of curricular subjects throughout the planning sessions. Collaboration involved professionals with distinct roles during the entire process and influenced all lesson study stages. It started with the negotiation of conditions necessary to implement the lesson study with education managers and extended beyond the space-time boundaries of lesson study. Micro-investigations on teaching and learning processes in the classroom were possible due to the lesson study dynamic, allowing teachers to study their own practice, experiment with a new practice (research lesson), discuss and reflect on this practice and on the students' learning from this lesson, and acquire new understandings of these processes (teaching and learning) after a reflection with peers and experts.

Therefore, these experiences represent an important initiative for promoting teacher professional development because they bring to mathematics and sciences education a different perspective on thinking and stimulating teacher education: the lesson study. Besides, they have contributed to strengthening knowledge on the implementation of this approach in the Portuguese context and spread it to other Western countries. However, discussions on this theme do not end here, as many aspects and processes involved in teacher professional development concerning lesson study need to be further investigated. Also, we need to understand better how this approach is carried out in contexts different from that of Japan and what we can learn from it.

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## ABOUT THE AUTHOR

ADRIANA RICHIT has a doctorate in math education from the Universidade Estadual Paulista (UNESP). She is a professor at the Universidade Federal da Fronteira Sul (UFFS).

*E-mail:* adrianarichit@gmail.com

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