




Lesson study in primary initial teacher education: Participants' perspectives on potential and challenges

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Abstract

Our aim is to identify the participants' perspective about the potential and challenges of using mathematics lesson study (LS) in initial teacher education (ITE) of preservice primary teachers. We present two lesson studies and analyze the perspective of preservice teachers and teacher educators. The results suggest diverse kinds of potential and challenges. This research provides new insights about using LS in ITE and aspects to be considered by teacher educators who wish to use this formative process, particularly: constitution of the working groups, methodology and approach of the sessions, research lesson, assessment, collaboration, presentation of the process and duration.

Keywords: lesson study, initial teacher education, preservice teachers, formative process, teacher collaboration, practicum, mathematics

INTRODUCTION

Lesson study (LS) is a formative process with more than a century of history in Japan (Makinae, 2010). With the publication of the book *The teaching gap* (Stigler & Hiebert, 1999), it spread all around the world. Over the years, many investigations on LS have been carried out. However, its characteristics and potential, especially for a greater connection between theory and practice and for the development and deepening of participants' knowledge, make it continue to be intensively researched.

Initial teacher education (ITE) has been the focus of several studies to improve the quality of training for preservice teachers, since this process faces many challenges and problems (Strutchens et al., 2016). The quality and improvement of ITE is a concern all over the world and LS is a formative process that may help to address this problem. However, to better understand this formative process in ITE, we must have a better understanding of its potential and challenges.

Although LS did not originate with preservice teachers, more and more researchers are focusing on this area due to its potential for the development of preservice teachers' knowledge. There are interesting experiences in several countries (e.g., Cajkler et al., 2013;

Leavy & Hourigan, 2016), and, more recently, the study of the potential and challenges to enhance our understanding of the process (e.g., Tan et al., 2024). Quaresma and Ponte (2017) conducted a study in Portugal on the perspectives that participating in-service teachers had on this formative process. In order to better understand the integration of LS in ITE, it is equally important to carry out research with a focus on the preservice teachers' perspectives. This will enable educators to adapt the LS to the needs of the participants and enhance their learning and development.

Thus, this article aims to identify the perspective of the LS participants, particularly the preservice primary teachers and the teacher educator, about the potential and challenges of the use of LS in ITE in Portugal. A distinctive and relevant aspect of this study is that it involves two different adaptations of LS in the same institution, allowing us to explore the differences between the two cases. The analysis of the participants' perspectives enables us to deepen our knowledge and understanding of LS in ITE. In addition, it enables us to deepen current understanding of the process about its potential, but also about the challenges that may arise, allowing the development of strategies to overcome them. The results of this study may help to adjust the necessary adaptations of LS and, consequently, to improve the preparation of preservice teachers. With

Contribution to the literature

- This research illustrates two adaptations of lesson study in initial teacher education of preservice primary teachers in the same institution.
- By analyzing the participants' perspectives, this research highlights a synthesis of the potential and challenges of developing lesson studies in initial teacher education.
- This research provides aspects to consider when developing lesson studies in initial teacher education.

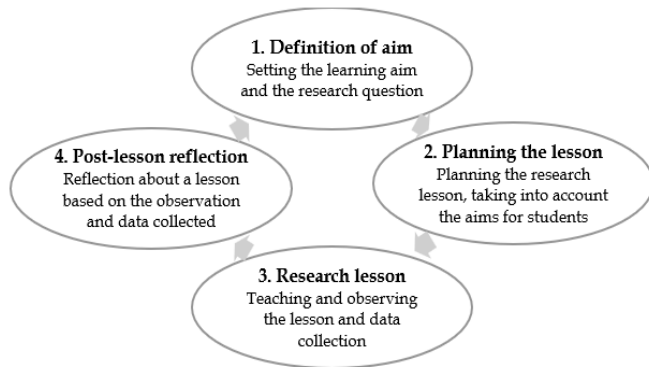


Figure 1. LS cycle based on Murata (2011)

better knowledge of this process, its benefits and obstacles, it may be possible to improve the quality of ITE.

LS as a Formative Process

In LS, a group of teachers works on the detailed design and planning of a lesson and then teaches and reflects upon the lesson. It is characterized by being centered on students' learning and by its collaborative and reflective nature (Cajkler et al., 2013). The focus on student learning enables changes in teaching practice, based on specific learning outcomes rather than on general teaching theories (Stigler & Hiebert, 1999). In addition, LS allows participants to understand the possibilities and importance of collaboration (Murata, 2011). It is a small investigation of the teachers on their own practice (Quaresma & Ponte, 2021), and thus a powerful process to promote their learning.

LS includes several phases, each consisting of a number of sessions, i.e., a number of meetings with all the members of the group, forming a cycle (Murata, 2011) (Figure 1). In the first phase, the group defines the students' learning aim (e.g., to develop the students' mathematical reasoning) and constructs the research question they intend to address throughout the process (e.g., how to develop the reasoning process of generalizing in students when they are working about sequences?). In the second phase, the group carries out an analysis of the curriculum guidelines, teaching materials, books and articles related to the students' learning on the selected topic. Then, the teachers elaborate in detail the plan of a lesson, through the solution, analysis and adaptation of tasks, definition of teaching strategies, anticipation of students' possible

difficulties and solution strategies, and preparation of the whole-class discussion. In the third phase, a group member teaches the lesson, and the other members observe, taking notes on the students' learning based on the previously decided observation and assessment instruments. Finally, in the post-lesson reflection, the group discusses and reflects on what was observed and what can be improved, which may lead to a reformulation of the lesson plan. The participants may decide to teach the lesson again. In this case, another member of the group teaches the lesson and the others observe, repeating the process. The main mechanisms that promote teacher learning in LS is the joint definition of a problem, the study of issues and proposals to deal with this problem, the careful framing of a lesson and the reflection on its enactment based on empirical data. When cooperating teachers from schools participate in LS in ITE, they may bring their experience and their deep knowledge of their students. Important features are the collaborative nature of this process, bringing to the group the different views and experiences of each participant, since the teacher educator, the cooperating teacher and the preservice teachers have different knowledge and experiences (Larsen et al., 2018; Ponte, 2017; Valente & Maurício, 2022).

LS is adaptable to different contexts and is an effective process for analyzing practice (Murata, 2011). Through this cycle, participants may develop and deepen their knowledge of students' needs, their difficulties, and how they learn a specific topic and develop the ability to observe students' learning (Murata, 2011). The fact that participants observe their lesson plan in practice and how their choices affect students' learning enables professional growth (Murata, 2011). Thus, LS enhances the development of knowledge of the participants, not only related to pedagogical content knowledge, but also on general aspects of teacher practice (Ponte et al., 2016).

Conducting LS outside Japan poses the problem of deciding what adaptations are necessary, as this process is integrated in a different culture (Seleznyov, 2019). Murata (2011) identify essential characteristics so that the nature of the LS is not severely altered—the fact that LS attends the interest of the participants, is focused on students, has a research lesson, and is a reflective and collaborative process.

Research About LS in ITE

Research on LS in ITE has gained significant prominence (Larssen et al., 2018), given its potential for the development of teachers' knowledge, to support overcoming weaknesses pointed out to ITE and its possibilities of adaptation to different contexts. The studies carried out about LS in ITE show that the LS integration in ITE programs is complex. Most studies focus essentially on the benefits of this formative process. There are few studies that address the difficulties or that explore the conditions for LS to be integrated into ITE (Kanellopoulou & Darra, 2019). Therefore, to deepen current knowledge of the research carried out on LS in ITE, we identify the potential and challenges mentioned in different studies.

Regarding the potential identified in previous studies, Kanellopoulou and Darra (2019) mention as benefits effective cooperation, enhanced professional development, deeper reflection and discussion carried out in planning, practice, observation, and feedback. For Baldry and Foster (2019), LS allows it to deepen or even transform the partnership between the university and the school. By participating in a LS, preservice teachers have the possibility of acting as researchers, discussing and reflecting on various aspects of a mathematics lesson that they later put into practice in the research lesson, linking theory and practice (Baumfield et al., 2022). Additionally, preservice teachers develop and deepen their knowledge (Lamb & Ko, 2016), including pedagogical content knowledge, knowledge about mathematical concepts and processes (Hourigan & Leavy, 2019), about the curriculum and students' needs, and develop their ability to observe learning and increase their self-confidence (Larssen et al., 2018).

Regarding challenges, Shinno and Yanagimoto (2023) identify three dimensions when investigating the conditions and constraints of LS in ITE: institutional, such as difficulty in organizing the group or limited resources; educational, such as the distinct roles that preservice teachers have when compared to in-service teachers who participate in LS (e.g., not teaching the research lesson); and personal, such as the reduced practice of preservice teachers, namely limiting the anticipation of students' solutions.

Also about challenges, previous LS developed in ITE indicate challenges that are covered in the three dimensions of Shinno and Yanagimoto (2023). At institutional level, an issue is the harmony with the other activities that are already taking place (Hourigan & Leavy, 2019). This can be challenging as LS requires time to carry out all its phases (Baumfield et al., 2022) and it may be difficult to fit within the structure of the ITE program (Leavy & Hourigan, 2016). Another challenge is related to the possibility of having a large number of preservice teachers, which requires several university teachers as well as schools, and it is necessary to

establish partnerships and communication between the participants: preservice teachers, university teachers and cooperating teachers (Ponte, 2017). Related to the educational dimension, Baumfield et al. (2022) address the discomfort that some university teachers feel to carry out LS. At personal level, Hourigan and Leavy (2019) mention the limited knowledge that preservice teachers have about students, even when they have contact with the class. This reduced knowledge about students, the lack of experience and the lack of knowledge that preservice teachers present to reflect, may condition an in-depth reflection throughout the LS (Baumfield et al., 2022). Despite some studies that identified problematic aspects, more studies are needed that address the difficulties and conditions (Kanellopoulou & Darra, 2019).

Adaptations of LS to ITE

LS may be integrated into ITE and enable the achievement of objectives related to the development of preservice teachers. However, given that it was originally developed for in-service teachers, several adaptations are necessary. Making these adaptations can be very challenging (Lewis, 2019), since preservice teachers have less knowledge and experience and are part of an institution that has a well-defined program and structure. Even so, several adaptations have been made. Cajkler et al. (2013), follow a model very similar to the Japanese. These LS usually take place with preservice teachers who are in the context of teaching practice that is part of the ITE program. The preservice teachers experience the four phases of the cycle and teach research lessons with students from school. As the authors point out, an LS enables an approximation between theory-practice and between teachers-preservice teachers and allows to deepen participants' knowledge. Other authors, as Fernández and Zilliox (2011) and Bieda et al. (2015), resort to other adaptations of the LS. In the microteaching lesson study of Fernández and Zilliox (2011), the research lesson is taught at the university, among preservice teachers. In this case, preservice teachers have no contact with a real classroom context, limiting the potential of this formative process. In the mentor-guided lesson study of Bieda et al. (2015), during the research lesson, the preservice teachers first observe and only then teach. In this adaptation there is also an active involvement of the teacher educator who guides the process and influences the course of the LS.

In addition to these adaptations, there are many methodological and organizational decisions that can change in each context, such as the number of research lessons, the number of sessions, the characteristics of the working group or how the assessment of the preservice teachers is carried out (Baumfield et al., 2022). Besides these aspects, adaptations may also arise in relation to the structure of the sessions, the number of participants and the roles they play, the tasks that are proposed in

each session or the teacher education focus given to the LS. These adaptations can vary with greater or lesser intensity and define the LS carried out in each context (Larsen et al., 2018; Ponte, 2017).

LS carried out in ITE involve participants with different roles, as well as different levels of knowledge and experience. In this respect, Ponte (2017) indicates that it is important that preservice teachers have some freedom and decision-making influence during the LS, feeling responsible for the decisions that are made and feeling that their ideas are worth considering by the group.

In a literature review on how LS is integrated into ITE, Baumfield et al. (2022) indicate that, in general, it is carried out in partnership between schools and higher education institutions, although there are cases in which it involves only one of them. In LS carried out with in-service teachers, an expert designated as a “knowledgeable other” is often invited to participate in some sessions and poses questions that generate discussions and reflections that deepen the teachers’ knowledge. In ITE, this role of expert is usually assumed by the teacher educator that guides the discussions and raises questions that promote the progress of the process and also the development of the preservice teachers’ knowledge.

Ponte (2017) refers to the importance of considering whether preservice teachers teach the research lesson, especially if the LS is carried out at an early stage of the teacher education program, in which they have little teaching experience, which might be a constraint. Schipper et al. (2020) mention that it is essential to clarify the formative process with preservice teachers and ensure that they get involved in LS. However, Lewis (2019) draws attention to the fact that the participation of preservice teachers is often not voluntary, since it is the university teacher educator who presents the process and leads them to join and live this experience.

LS in ITE with a format similar to the original seems to bring all the potential that has already been pointed out in research developed with LS for in-service teachers. However, given that preservice teachers have little practice and knowledge, the teacher educator needs to play a more active role in guiding them. In Portugal, in general, in LS developed in ITE, teachers and preservice teachers work as a group, with the teacher educator guiding and orientating the sessions, and the research lesson is taught in a classroom context (Duarte et al., 2024; Martins et al., 2023). LS usually follow an exploratory approach (Ponte, 2005), similar to what in Japan is called structured problem solving (Fujii, 2014). However, different adaptations were needed to the other factors already highlighted, leading to diverse LS in Portugal (Duarte et al., 2023; Ponte et al., 2016; Vieira et al., 2022). All these experiences are quite different and point out some of the potential and challenges that have

arisen, but their focus was not to explore these aspects in depth. In addition, the perspective of the participants was little explored in both national and international research.

METHODOLOGY

Context

In Portugal, ITE for preparing teachers for early years (grade 1-grade 6) has five years. The first three are a bachelor’s degree, in which preservice teachers complete a set of subjects and educational courses and then select a specific master’s degree with a duration of two years. In this article, we present two LS. Both were carried out in the master’s degree combined program for 1st cycle of basic education teachers (6-10 years old students) and 2nd cycle mathematics and science teachers (11-12 years old students). The LS were carried out at the same institution, in two different academic years.

The LS followed a cycle based on what is presented by Murata (2011) and similar to the LS in Japan, as in Cajkler et al. (2013). The teacher educator (Regina, pseudonym) and the researcher (first author) participated in the two LS. The researcher assumed the role of participant observer, intervening only sporadically during the sessions of phase 2 and phase 4 of the LS, with some questions to address or reflect on, and holding meetings with Regina to structure and prepare the aim and activities of each session, but it was Regina who made the final decisions. Regina has been an educator for more than 20 years and already learned about the LS process and participated in some events about LS, even though it was the first time she was carrying out LS. She conducted all the sessions of the LS.

Lesson Study 1

LS 1 was carried out in the academic year 2020/2021, in the 2nd semester of the 2nd year of the master’s degree. It was integrated into the course of supervised teaching practice, which the preservice teachers began, in a class, with two weeks of observation, followed by seven weeks of teaching practice, where the LS took place. The participants were two preservice teachers (Jessica and Barbara, pseudonyms), the cooperating teacher (who accompanied the two preservice teachers at school), Regina (who guided the preservice teachers at the higher education institution) and the researcher.

In this LS, Regina, the cooperating teacher and the preservice teachers worked as a group, sharing ideas, discussing and making decisions together. The LS had four phases, experienced by all participants, totaling seven sessions (Table 1). Most sessions were held online (because of COVID-19 restrictions), but it was possible to carry out the research lesson face to face, as well as the first post-lesson reflection session immediately after the lesson. The preservice teachers co-taught the lesson that

Table 1. Structure of sessions of LS 1

Session	Session aim
1 (online)	What is LS (by Regina and the researcher), choice of the topic, and definition of the aim
2 (online)	The LS group planned the lesson by selecting, solving, and adapting tasks
3 (online)	The LS group planned the lesson by anticipating possible solving strategies and difficulties; and planned the observation
4 (online)	The LS group reviewed the lesson plan
5 (face to face)	Research lesson taught by the preservice teachers and observed by the rest of the group
6 (face to face)	The LS group reflected on the actions of preservice teachers and the lesson
7 (online)	The LS group reflected about the tasks, students' solutions and students' learning

Table 2. Structure of sessions of LS 2

Session	Aim of the aim
1	Presentation of the LS by researchers with the sharing of in-service teachers
2	The preservice teachers solved the pyramids task and developed the planning: topics, aims, and teaching methodology
3	The preservice teachers anticipated the students' solutions and difficulties; teacher questions; sequencing solutions; preparing the observation
4	Research lesson taught by the in-service teacher and observed by some preservice teachers and the teacher educator
5	Presentation and discussion of reflection of preservice teachers' papers by the preservice teachers and the teacher educator

focused on the topic of numbers and operations (mental computation: addition and subtraction), and Regina and the cooperating observed the research lesson.

Lesson Study 2

This LS was carried out in the academic year 2022/2023, in the 1st semester of the 1st year of the master's degree. Regina decided that LS 2 would involve a whole class, so it was integrated into the course of didactics of mathematics at the 1st and 2nd cycles of basic education and involved 35 preservice teachers (the names indicated are pseudonyms), who worked in small groups (3-4 per group). Since the course did not provide preservice teachers teaching practice, Regina invited an in-service teacher to integrate with the LS, who had a smaller involvement than in LS 1. Due to the high number of preservice teachers in the class and to focus the lesson on the students, Regina and the teacher selected the topic and the task without the student teachers' participation, so that all groups would work on the same task. The teacher was not present at the planning sessions but had access to the lesson plans made by the preservice teachers before the lesson and taught the research lesson.

Although the LS had more adaptations to the context, it maintained the characteristics that Murata (2011) enunciates as essential to this formative process. Thus, although the selection of the topic was not made by the preservice teachers, the process was focused on the students, since the topic and task were selected by the teacher based on her knowledge of the students; selected preservice teachers observed the research lesson; and the process was a reflective and collaborative.

The research lesson focused on a geometry topic (pyramids). The LS consisted of five sessions (**Table 2**), all face-to-face. Due to the high number of preservice teachers, in the research lesson, besides Regina, the teacher and the researcher, just one member of each preservice teachers group observed the lesson, who later shared the field notes with the other members of the group.

Design, Data Collection, and Data Analysis

The research follows a qualitative approach within the interpretive paradigm (Erickson, 1986), adopting the design of participant observation (Jorgensen, 1989). This study analyzes the two lesson studies described above. As these are two possible adaptations of LS to ITE, they enrich the data and conclusions about the perspective of the participants, particularly the preservice teachers and the teacher educator on this formative process.

The data were collected through observation, with video recording (in online sessions) or audio recording (in face-to-face sessions) of the sessions (S_x) and writing a research journal and doing semi-structured interviews with preservice teachers and the teacher educator at the end of the LS. There was also document collection including the final written reflection in LS 1 and the final papers of the groups (FP G_x) in LS 2, carried out within the courses in which the LS was developed. The semi-structured interview was individual, organized in blocks, and consisted of questions related to the formative process in general, followed by particular questions about each phase of the LS, with focus on the specific adaptations of each LS and also questions based on situations observed and recorded by the researcher,

with the intention of identifying the potential and challenges from the participants' perspective.

Data from observation of sessions, interviews and document collection were triangulated for an in-depth analysis of the participants' perspectives, which were essentially derived from the interviews and final papers. The data analysis was inductive, with content analysis (Bardin, 1977). It began by identifying, from the data collected, potential and challenges reported by the preservice teachers and by the teacher educator about the two LS that were carried out. We consider as potential the aspects mentioned by the participants as positive or positive influenced the development of the formative process. Challenges are the aspects that have negatively influenced or limited the development of the preservice teachers or the development of the process, requiring changes or adaptations from the teacher who conducted the sessions or from the structure of the process so that they could be overcome or managed in a fruitful way. Once the potentials and challenges had been identified, they were coded. After coding, the strengths and challenges identified by the preservice teachers and the teacher educator were cross-referenced with the data from the transcripts of the sessions and the research journal. Once identified, potential and challenges were grouped, based on Shinno and Yanagimoto (2023) dimensions but with adaptations, into

- (1) institutional aspects, related to the structure of the program and the curriculum, including time (related to the moment of the ITE in which it was developed and the difficulty of reconciling with the other activities), hierarchy (different roles of the participants) and assessment (intrinsic to ITE),
- (2) personal aspects, related to the participants, including their knowledge, experience, background, characteristics, capacity and skills, which gave rise to the participation and involvement of the participants, the experience of preservice teachers, and the development of preservice teachers' knowledge, and
- (3) process characteristics aspects, related to the nature of the LS process, including time (related to the duration and number of sessions), understanding the formative process, the organization of the sessions, the link between theory and practice and between institution and school, the work developed between the different participants, detailed planning and reflection.

The analysis resulted in a set of categories and subcategories. Some categories and subcategories end up influencing the others, as can be seen in the results section. The results section is organized into these three dimensions.

RESULTS

Lesson Study 1

Institutional aspects

Regarding institutional aspects, several challenges were identified. Issues related to time, hierarchy and assessment emerged.

Related to time, Jessica suggested to rethink the moment to undertake the LS, anticipating it in the program:

Considering all that we have to do in teaching practice ... It complicates a little in terms of time ... So many assignments we have to do ... It is difficult to reconcile everything and do it well ... Think about doing it before the final teaching practice (Jessica).

Time also emerged as a challenge related to the several sessions needed to carry out the LS, combined with the many activities of the master's program that already occur.

Regarding the different hierarchical roles and positions of the participants, Regina stated that

although we all had different roles, I think there was a participation tending towards egalitarianism.

The preservice teachers had a similar opinion:

They are "above" us ... But then, there, when we're really at the table, there are situations where you feel more, there are situations where you feel less, but we can be a team ... [The LS] demystifies hierarchy a little bit (Barbara).

The preservice teachers recognized that they were able to overcome differences in status and work collaboratively with the teacher, which was also visible throughout the LS sessions. This challenge was first identified by Regina. In the following sessions, it was observed that she sought to overcome this challenge by the way she guided the discussions, inviting everyone to present their views, building an environment of discussion and sharing. They worked collaboratively during lesson planning, making decisions together and then reflecting on the lesson, the decisions made and students' learning.

In relation to the assessment carried out in the course which includes the research lesson, the preservice teachers presented different opinions:

It's a little stressful at first, but I think then when you begin doing things you end up abstracting from that too ... The teacher attended a lesson ... And it was great because it was a lesson that was

already more thought out, so it would also go better from the beginning (Jessica).

[The assessment] is something that affects heavily ... It was great for us to participate, but then it's also the pressure ... Even if it's not by the assessment, as much as we don't want to lose our focus or be more nervous, we always have more eyes looking at us (Barbara).

The assessment of preservice teachers is an aspect of ITE and combining LS with assessment is a challenge, particularly regarding the research lesson. The lesson is planned together, but the teacher educator, besides being an observer, also has the role of assessing the preservice teachers. In this case, Jessica and Barbara have different opinions about the influence of assessment on LS. This difference of opinion may be related to personal aspects of the preservice teachers themselves and their confidence to teach the lesson with observers.

Personal aspects

Personal aspects were identified in relation to participation and involvement and the development of knowledge. Addressing the involvement of preservice teachers, Regina mentioned a challenge she had not anticipated:

The different [weaker] involvement on the part of the two interns ... I wasn't expecting that ... There, in the initial sessions, I may have felt that I made too many interventions ... [I should] give them space to come up with their ideas ... [That is] the challenge of managing the session (Regina).

Barbara confirmed her lower participation in the LS, visible when she stated that if she could change something, it would be

to be able to cooperate more than I did and try to believe more in myself and in my abilities and give more ideas.

This challenge could influence the development of the process, since the involvement and participation of the preservice teachers and the creation of a collaborative environment are fundamental. Although Regina did not foresee this challenge, she said that it was overcome by encouraging preservice teachers to participate and giving them time to intervene.

The development of the participants' knowledge was visible throughout the sessions, and they acknowledged it. Jessica mentioned aspects of pedagogical content knowledge that she considered deepened:

To know activities, to do research ... It was good in terms of learning, having more knowledge ... To see the different things that could happen and the different ways they [students] could think ... We

were concerned that we would have those moments [exploratory teaching], and indeed we did, and I think that contributed to the success, both of the lesson and of their learning ... It helped me realize that ... It's worth taking the trouble to promote this to happen (Jessica).

Working on subtraction strategies, I really enjoyed seeing their productions ... In terms of mathematical concepts, we worked a lot on sharing strategies, reasoning and mental calculation ... It was good to see it again ... If it were another topic, I would challenge myself much more and would bring new [mathematical] knowledge and learning (Barbara).

Jessica mentioned deepening her knowledge about tasks, students' solutions and exploratory teaching. Regarding mathematical knowledge, although with less evidence, Barbara mentioned aspects that were mobilized, such as subtraction strategies, that she had the opportunity to review. She added that with a more challenging topic, the development of mathematical knowledge would be greater. The preservice teachers highlighted the characteristics of the LS and the activities in the process that fostered this development, such as anticipating different strategies and then observing what the students did. They also highlighted the possibility of putting different methodologies into practice and the investigative nature of the LS. In terms of personal aspects, the challenges were the involvement and participation of the preservice teachers, particularly Barbara, during the sessions. As potential, the development of pedagogical content knowledge and mathematical knowledge emerged.

Process characteristics aspects

Characteristic aspects of the process were often mentioned: time, understanding the process, collaboration, detailed planning, and organization of sessions.

In Regina's opinion, time and understanding the process were two challenges:

It was an activity much extended in time, and I doubt if they made total sense out of it ... The pace of work in the internship is not compatible with planning a lesson like this, with this anticipation of a series of weeks (Regina).

LS requires carrying out several sessions and Regina considered this a challenge. In addition, the complexity of the process, which involves several stages of a cycle, in her opinion, makes it difficult for preservice teachers to understand the process.

Collaborative work was mentioned as potential. For Jessica,

working synchronously like this doesn't [usually happen] ... [But] it even leads to avoid that there isn't that flow [of opinions] that we sometimes have ...

She indicated that the collaborative work, as it was done, enabled a greater approximation between the school and the teacher education institution. She added that the lesson was planned

together with all of us, it was not just me and Barbara, but us too ... It's good to exchange ideas. Especially with those who have more knowledge than us,

acknowledging that the participants of the LS had different experiences and that this was a contribution to the discussions. Barbara also pointed out the advantages of this collaboration:

We have the idea of the terrain, a teacher who knows the target group ... We have the teacher educator component ... To do a little bit of what the [teacher education] taught us ... It's a connection that turns out to be advantageous for both for us, and then for the activities, and for the children ... Being able to connect the teacher education more and more with the internship ... The connection was much better, and it didn't seem like something that fell from the sky (Barbara).

Collaborative nature is a fundamental aspect of the LS, and the participants valued it. Jessica and Barbara said that the collaboration brought the school and the higher education institution closer together and had an influence on their development of knowledge, given the exchange of experiences and discussions provided by the activities carried out during the process. Regina indicated that the detailed planning was another potential:

Focusing on a single lesson and having thought about a series of details, I think it was an added value not only for the preparation of the lesson, but to understand how certain aspects have ... To be taken care of in the day-to-day planning ... It can even help mitigate this challenge, which is a very challenging moment in the lesson, which is the time of leading the discussion (Regina).

The LS encourages detailed planning in which the group analyses several aspects of the lesson over several sessions. This was another aspect that differentiated participation in this formative process from the usual planning by preservice teachers, made with less depth and analysis. Regarding the structure of the process, Barbara mentioned reflection as a potential. She pointed

out that sharing and reflecting were the most important aspects in the LS:

Sharing everything, activities, opinions, creativity, how it went, how it should have gone, how we can do it. Sharing and advising on what we could do better next time ... [It helped to improve] the ability to reflect, no doubt. Reflecting before, reflecting during, and reflecting after, but mainly reflecting after (Barbara).

Barbara highlighted the reflection and the opportunity to develop this capacity, through the several moments of discussion that made her reflect and showed that this reflection was related to the plan-observe-reflect cycle provided by LS.

Regarding the organization of the sessions, LS 1 had the particularity of being carried out online. This factor does not seem to have a significant impact on Jessica, who said that

it makes a difference in some smaller aspects, but I don't think it's anything that compromises the work that has been done.

However, Barbara would prefer working face to face:

I believe the connection would have been greater.

In Regina's opinion, being online

made it a lot easier [to scheduling sessions] ... I see no reason not to take advantage of this more hybrid regime now.

Regarding characteristic aspects of the process, collaboration, detailed planning and reflection were identified as potential. Time, understanding the process and organizing the sessions were mentioned as challenges.

Lesson Study 2

Institutional aspects

In relation to institutional aspects, assessment and knowledge of the context were identified.

Regarding the assessment, Regina indicated that:

The fact that here planning is done as class work and is not an object of assessment also made them feel less with that pressure of assessment and there was greater discussion, interaction and sharing between the ideas of the several groups (Regina FI).

Regina reflected on the influence that the assessment of preservice teachers may have on the development of LS when it is a preservice teacher who teaches the

research lesson. Also, the preservice teachers mentioned that assessment was not the main issue:

[LS] focuses on the students and not the teachers. When we're being evaluated, in an internship context, we're always nervous ... What matters here are the students, the difficulties that the students have and what we must do to improve ... (Alice, S5).

Despite not having taught the lesson, this preservice teacher reflected on the LS and the influence of assessment, saying that the important thing were the students. Assessment is an aspect to consider when developing LS, as it is part of the course, but in this case the preservice teacher did not consider it a challenge or a potential of LS. About the lack of knowledge about the context, the participants mentioned an influence mainly on planning:

we asked, 'how are we going to do this [anticipate], if we don't know the class?', then the teacher tried to help and guide, but it was a difficulty (Bianca).

Lack of knowledge was a challenge, because in LS, planning is expected to be detailed for a specific group of students, which in this case the preservice teachers did not know, making it difficult to carry out some activities, such as anticipating strategies and difficulties. The preservice teachers only had more general information about the class, namely the number of students and the content already covered in geometry. Particularities of the class and characteristics about the students and their difficulties and learning were not shared. It is a challenge at an institutional level, since the preservice teachers did not have prior contact with the class, as they were not in a practice context. Thus, assessment was not pointed out as a challenge or a potential of the formative process by the participants. In this case, the challenge emerged related to the lack of knowledge about the context.

Personal aspects

As personal aspects, participation and involvement, knowledge development and practice/experience were identified. In relation to the involvement of the cooperating teacher, the participants mentioned it was small:

In the planning phase, the teacher could have tried to come to our classroom ... To present the more common difficulties that the students had (Helena).

In the planning phase, a greater articulation, with the teacher who was to lead the lesson ... That would be an aspect to improve and take care of (Regina, S5).

Preservice teachers found it difficult to plan, which is related to the lack of knowledge about the students, as already mentioned in the institutional aspects. However, it is also related to another challenge which is the participation and involvement of the in-service teacher, since this challenge could be minimized with greater participation of the cooperating teacher. Regina helped to overcome these difficulties, but considered that:

The connection between what was done in class and then the research lesson ... It was a big challenge, and it wasn't totally overcome ... I sent them what they did, but there was no opportunity either before or after the lesson to hold more conversation and interaction between the [preservice teachers'] class and the teacher (Regina, FI).

Regina considered that the teacher's lack of participation highlighted other challenges such as the gap between what was planned and what happened in the research lesson.

Regarding the development of knowledge, the preservice teachers reported having developed knowledge about "pyramids" (Alice), and:

We were more prepared for the lesson because we did all this in anticipation of the results... It allowed the analysis of results ... I realized the importance of discussion ... [First] organize exploration tasks and then have this discussion ... Guiding the discussion, yes, and the reasoning part, was what I developed the most (Bianca).

We plan very well the difficulties that may arise, the feedback we can give ... The importance of choosing a strategy, of sequencing. The importance of us acting as a guide and not as a person who practices directive teaching (Marina).

The preservice teachers mentioned the development of knowledge essentially related to pedagogical content knowledge, and a preservice teacher mentioned mathematical knowledge on the topic. The participants referred also to

"personal, professional and social development" and "the formation of critical and reflective capacities", which represents an important "evolution" (FP G6).

For this development, the preservice teachers mentioned the anticipation of strategies, difficulties and sequencing of answers, as well as reflection on what they observed. They also highlighted the possibility of observing the exploratory approach in practice and collaboration.

The little experience of preservice teachers was another factor that influenced the anticipation of students' answers:

[it was] sometimes difficult to imagine wrong answers or to put ourselves in the shoes of the students (Daniel).

Regina also stated that anticipating answers was

a challenge ... Because they don't have that experience of knowing what the students might think (Regina, FI).

Little experience is an expected challenge when developing LS in the context of ITE.

The personal aspects identified as challenges were the involvement of the cooperating teacher and the lack of experience of the future teachers. As a potential, the development of knowledge was highlighted.

Process characteristics aspects

Time, understanding of the process, collaboration, greater connection with practice and between institutions, reflection and the organization of sessions were identified as characteristic aspects of the process.

About the duration of the LS, the participants felt that, after the research lesson,

everything was very fast, we had to do everything a bit in a hurry (Helena).

Post-lesson reflection is an important moment for preservice teachers to discuss what they observed and compare with what they planned, and, in this case, they only had a session to share and discuss with the whole-class. Even so, they considered that the post-lesson reflection

was where I was able to clarify whether my ideas and the conclusions we reached were right or if there were things we missed (Daniel).

Regarding the understanding of the process, the preservice teachers mentioned that they only achieved it in the final part of the experience:

[The] process was not understood, at least by me, while I was experiencing it ... As I didn't know the purpose of that, at first it seemed to me to be just another assignment of those that they told us to do. At the end, I really realized what an LS is ... (Francisca).

[With the first session] they could be able to witness from in-service teachers ... It helped me to understand what LS consists of (Regina, FI).

Not understanding the process influences the involvement and participation of preservice teachers. The first session took the form of a seminar for sharing an experience of LS with in-service teachers, this might have clarified the process. However, it was held outside of class hours and at a time when the participants did not understand its purpose.

Regarding collaboration, the preservice teachers identified that

it is a challenge to bring teachers and students closer together (Francisca)

and that

the decision-making moments were up to the main teacher which is more a relation of cooperation (Gabriela).

The preservice teachers questioned the collaborative work that existed with the teachers, suggesting that there was joint work but not real collaboration.

The possibility of going into practice was a potential of LS:

To analyze a worksheet in detail and then actually go to practice to see the results ... To have that contact with the students, because throughout our program we don't have that possibility much and I think it's a very good tool (Daniel).

Many of the teachers [in higher education] perhaps no longer have great contact with the reality of schools ... So going into the field and being asked for this kind of thing is much more advantageous because we have feedback from reality (Kevin).

From the participants' perspective, the LS allowed closer connections between theory and practice and also between the school and the higher education institution, helping to minimize a problem pointed out in ITE and to make the learning of preservice teachers more meaningful.

Regarding the way the sessions were organized, the preservice teachers recognized the benefits of working in small groups and the whole class. However, some of them pointed out that the whole-class reflection could have been managed in a different way:

I really liked this work methodology, I think it made it easier for us to be in a small group, to be able to give our opinion and then, in the discussion phase, share it with the class, I think that was beneficial (Bianca).

The way it was done [the reflection] was not as fruitful as it could have been (Kevin).

This organization of sessions was different from what usually happens in a LS. In the preservice teachers' opinion, this moment of the whole class could have been richer and more meaningful if there had been greater participation and discussion among them.

There were also different opinions about the organization of the sessions, particularly the research lesson. Some participants considered that

you can observe better if you don't have to teach yourself. Therefore, I feel that it would not be more advantageous [to teach] ... It was good for us to just be able to observe (Francisca).

Others indicate that

it would be even richer for the process ... We would implement it (Bianca).

In addition to who teaches, there is the question of who observes, and it was a challenge for those who did not have this opportunity,

because it turned out to be something that someone else experienced and not me, so it doesn't bring as much meaning to me (Marina).

Regina also acknowledged this challenge, although she considered that

this communication was well done ... The other elements were able to keep up (Regina, S5).

Still related to the observation of the research lesson, the preservice teachers added that

this moment was lived with some difficulty because we felt the need to have at least two elements of the group to observe, in order to record everything that was intended (FP G5).

That is, the preservice teachers mentioned the need for more than one member of each group seeing to have more records and field notes of what happened during the lessons. The decision of who teaches and who observes the research lesson influences the process and may influence the participation and involvement of the preservice teachers and is, therefore, a challenge. Still about the organization of sessions, the teacher educator and the cooperating teacher selected the task. Regina stated that

it was the option taken, but it would be possible [to be the preservice teachers] ... There could be several dynamics.

From the perspective of the participants, some consider that this option meant that

we were not part of the whole process, so we ended up not having a very realistic view of what LS is (Gabriela)

and that it would give

another responsibility to us, we would be more connected with it ... More involved.

Others considered that it was good because:

We didn't know the class ... So, I think the ideal was that it wasn't made by us ... Because the teacher Regina knows us and what we can do or not, and the cooperating teacher knows the class (Alice).

Thus, some preservice teachers indicated that it would have been important for them to research, select and adapt the task, so that they would take more ownership of the lesson. This also seems to have affected the participants' understanding of the LS. However, other preservice teachers were comfortable with the decision made.

In terms of the characteristic aspects, there were potential such as the greater connection between theory-practice and school-institution, and reflection. However, there were also challenges such as time, understanding the process, collaboration and organization of sessions.

DISCUSSION

Two LS were carried out, with different adaptations in the same higher education institution, analyzing the participants' perspectives in relation to potential and challenges. Institutional aspects that emerged were time, hierarchy, assessment, and knowledge of the context. Personal aspects identified were participation and involvement, practice/experience, and development of knowledge. Finally, process characteristics aspects were the category in which more aspects were identified, namely, time, understanding the process, the organization of sessions, greater connection between theory-practice and school-institution, collaboration, detailed planning and reflection. The LS was a formative process with various potential that enabled preservice teachers to deepen knowledge and skills that they did not develop during their ITE, despite the various activities that they carried out previously. It is therefore important to analyze these potential and the challenges that arose, so that in the future challenges can be minimized or taken into consideration in LS to develop in this context.

Despite the different adaptations, there were potential common to both LS. Both followed an exploratory approach (Ponte, 2005) and were carried out in partnership between the school and the higher education institution. There was also a strong connection between theory and practice (Baumfield et al., 2022). In

both cases, the LS contributed to the development of the preservice teachers' knowledge, especially pedagogical content knowledge, but also, to a lesser extent, mathematical knowledge. Participants reported that several phases of the LS enhanced this development, highlighting the importance of experiencing the various phases and also the benefits of its reflective and collaborative nature (Hourigan & Leavy, 2019; Lamb & Ko, 2016; Larssen et al, 2018; Ponte, 2017). Thus, the results suggest as potential the detailed planning of a lesson, the development of knowledge, the reflection, the collaboration, the approach to practice through the research lesson, the strong connection between theory and practice and the connection between school and higher education institution.

If we look at the challenges, the results suggest the moment in which the LS was carried out (in LS 1), management of time (as in Kanellopoulou & Darra, 2019), reconciling with other activities, understanding the formative process, reduced participation of the cooperating teacher (in LS 2), lack of knowledge of the class (in LS 2), reduced experience and practice of preservice teachers (mainly in LS 2), hierarchy, preservice teachers' assessment and difficulty in observation (in LS 2).

These two LS highlighted some aspects that are important to reflect on. One of them is the constitution of the group, which can influence the involvement and participation of preservice teachers, an aspect mentioned by Schipper et al. (2020) as important. Although in LS 2 it was not possible to have a greater involvement of the cooperating teacher, this difficulty was minimized with Regina's knowledge about classroom practice. In LS 1, the importance of participating in the cooperating teacher was visible, as mentioned by the participants. The participation of the cooperating teacher can also help to minimize an aspect already mentioned in previous studies, the preservice teachers' limited knowledge of the class (Hourigan & Leavy, 2019).

Another essential aspect to think about when developing LS at ITE is the methodology of the sessions, namely how they are organized. This organization also includes research lessons. In LS 1, the preservice teachers taught the research lesson, and, in LS 2, they only observed. An aspect that Ponte (2017) mentions should be considered when doing an LS in ITE is to define who teaches the lesson. In LS 1, Jessica mentioned that this aspect was positive and that the lesson was planned in more detail, so she felt safer (as highlighted by Larssen et al., 2018). Some participants in LS 2 also considered the possibility of teaching the lesson as an advantage. However, Barbara and other participants in this LS questioned this aspect, pondering whether it is more positive to teach the lesson or just to observe. Linked to the research lesson and the whole process, there is also the issue of assessment, which must be analyzed to

minimize the influence in experiencing the LS, although this is an intrinsic feature in ITE.

Another aspect that Schipper et al. (2020) also address is the importance of participants understanding the process. In these two LS, despite the different initial approaches to the LS, it remained a challenge. This is something to reflect on in the future. It is necessary to consider how the process is presented to preservice teachers. But this leads to another issue, which is the duration of the process and the time when it is developed. Contrary to what is indicated by Baumfield et al. (2022), the two LS were carried out in the final phase of ITE and not in the intermediate phase, assuming that at this stage the preservice teachers already have more knowledge to discuss and to reflect on during the sessions. Regarding the moment in which it was carried out, in LS 1, the participants reported the difficulty of reconciling with the other assignments of the ITE program, a challenge already indicated by Hourigan and Leavy (2019). This aspect was improved in LS 2, by changing the moment of its development. In this way, reconciling with other assignments was no longer a negative aspect mentioned by the participants.

Ponte (2017) pointed out the importance that, when the LS is carried out with preservice teachers in which there are participants with different roles, they feel that their ideas are valued and pondered by the group. The two LS involved participants with different roles. While in LS 1, the preservice teachers said that, despite this difference, they all worked together, as a group, in LS 2, the preservice teachers mentioned that they felt more about this difference, since there was no such teamwork with the teacher educator and the in-service teacher. Related to this aspect arises the issue of collaboration, also more developed in LS 1 than in LS 2, which led some preservice teachers to consider that, instead of a collaboration, it was a cooperation with their teachers. Kanellopoulou and Darra (2019) also mention cooperation rather than collaboration as what takes place in these situations. According to Quaresma and Ponte (2021), it is possible to develop collaboration in groups that have participants with different roles, as happened in the LS. The preservice teachers LS 2 referred to cooperation not because collaboration was difficult, but because of the little participation and involvement of the cooperating teacher and Regina had to circulate throughout all groups. However, there was collaboration between preservice teachers. Even so, this is a field that needs further investigation, addressing the relationships between participants in LS as they have different roles, hierarchical positions, and knowledge.

This study deepens the knowledge about the adaptations of LS to primary ITE, enabling the identification of the potential and challenges of LS in this context, something that is not widely studied (Kanellopoulou & Darra, 2019). The two LS had a very different structure, even though they were developed in

Table 3. Synthesis of potential and challenges in lesson studies

Variable	Definition
Potential	<p>Greater connection Theory-practice Higher education institution-school With the classroom context</p> <p>Collaboration Among preservice teachers With teacher educators With practicing teachers</p> <p>Development of knowledge Pedagogical content knowledge Mathematical knowledge</p> <p>Reflection Describe/ explain/ act</p> <p>Nature of the formative process Plan-teach/observe-reflect</p> <p>Detailed planning Designing the task Design the lesson Anticipate difficulties Anticipate actions to be taken</p>
Challenges	<p>Lack of knowledge about the class Anticipation of difficulties Context and characterization</p> <p>Lack of practice/lack of experience Students Mathematics Pedagogical content knowledge</p> <p>Time Duration of the process Reconciliation with other activities Availability of participants</p> <p>Understanding of the formative process Strangeness</p> <p>Participation and involvement of participants Preservice teachers Teachers</p> <p>Institutional conditions Number of preservice teachers Availability of cooperating teachers</p> <p>Institutional hierarchy Teacher/preservice teachers</p> <p>Preservice teachers' assessment Existence of summative assessment process</p> <p>Formative process Organization and dynamic of sessions</p>

the same institution and with the same teacher educator conducting both. Although some aspects were similar in the two cases, these adaptations implied that each LS had its specificities. Considering the potential and challenges identified in the LS carried out and considering the literature review about LS in ITE, we synthesize the aspects mentioned in **Table 3**.

CONCLUSION

In this study, which involves two LS in the same institution, but with different adaptations, it was possible to indicate aspects that are important to consider to carry out an LS in ITE:

- (1) *constitution of the working group*, including the presence of the cooperating teacher, the role of the teacher educator, more or less intense, and the organization of groups of preservice teachers,
- (2) *methodology and approach of the sessions*, including whether or not they are online, what are the different moments of the sessions, whether it is only small group work or a combination of small group and whole-class work,
- (3) *research lesson*, namely who teaches and who observes,

- (4) *assessment of preservice teachers*, particularly the way it is done so that it does not disturb the formative features of the LS,
- (5) *collaboration or cooperation*, deciding how the relationship between the participants will be and how to manage the different roles,
- (6) *presentation of the LS to preservice teachers*, thinking about how to get them to understand the LS from the beginning in order to have them deeply involved, and
- (7) *duration*, specifically how many sessions for each phase of the LS so that preservice teachers have time to lead, deepen and reflect on each of them.

As Shinno and Yanagimoto (2023) point out, some factors influence others, and this was visible in these LS. These aspects are of relevance not only to Portugal, but also to other countries with similar ITE structure.

The fact that the participants' perspectives were the basis for this study may be considered a limitation. However, the perspective of those who experience the formative process is fundamental to its development and to improving integration of LS into ITE. Thus, knowing the participants' perspectives enables a deeper understanding regarding how they experience the process, allowing us to inform ITE. This information

may help to improve and adapt LS to create an environment and structure that is more beneficial to the development of preservice teachers. It can be used as a basis for future studies, thus moving towards the sustainability of this formative process in this context. It could be useful for further solid research to study professional development programs with more than one facilitator at more than one site.

Thus, this study brings to the research about the integration of LS in ITE a deepening of the aspects that may influence the development of LS through a more general reflection about its potential and challenges, providing a general framework. Of course, this framework is a starting point that can be improved with future work. However, this framework already shows relevant information that shows that LS, albeit facing challenges, brings relevant potential to ITE.

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