Journal of Education for Teaching

Routledge
Taylor & Francis Group

Lesson-study on health education with pre-service biology teachers

Journal:	*Journal of Education for Teaching*
Manuscript ID	CJET-2020-0254.R2
Manuscript Type:	Original Article
Keywords:	Lesson-study, Biology Education, Health Education, Pre-service Teachers' Education.

Abstract:	The purpose of this paper is to present an appraisal of a lesson-study implementation with pre-service biology teachers concerning a health education issue, how blood pressure works, and how it is affected. The participants were 11 pre-service teachers, a secondary school biology teacher, and three teacher educators from a local University. A qualitative and interpretative approach was followed. Data were collected through participant observation, content analysis of the pre-service biology teachers' individual written reflections, and their proposal of a lesson plan. The results evidenced the value of this formative approach, concerning the learning opportunities it offers, not only related to the scientific content knowledge but also the didactic knowledge developed by pre-service teachers. They seemed to develop a holistic understanding of how to teach a theme as multidimensional as this one, health education, but they also developed didactic knowledge related to different central aspects of the teaching process, concerning lesson planning, task development, classroom management, and communication, and became aware of the importance of developing several crucial competencies as science teachers. The lesson-study approach revealed to be a strategy for learning about teaching planning that has the particularity of bringing theory and practice remarkably closer.

Lesson-study on health education with pre-service biology teachers

Cláudia Faria* (cbfaria@ie.ulisboa.pt), Isabel Chagas (michagas@ie.ulisboa.pt), Cecília Galvão (cgalvao@ie.ulisboa.pt)

UIDEF-Research and Development Unit in Education and Training, Instituto de Educação, Universidade de Lisboa, Lisbon, Portugal

* Correspondence author: cbfaria@ie.ulisboa.pt

Abstract

The purpose of this paper is to present an appraisal of a lesson-study implementation with pre-service biology teachers concerning a health education issue, how blood pressure works and how it is affected. The participants were 11 pre-service teachers, a secondary school biology teacher and three teacher educators from a local University. A qualitative and interpretative approach was followed. Data were collected through participant observation, content analysis of the pre-service biology teachers' individual written reflections, and their proposal of a lesson plan. The results evidenced the value of this formative approach, concerning the learning opportunities it offers, not only related to the scientific content knowledge but also the didactic knowledge developed by pre-service teachers. They seemed to develop a holistic understanding of how to teach a theme as multidimensional as this one, health education, but they also developed didactic knowledge related to different central aspects of the teaching process, concerning lesson planning, task development, classroom management, and communication, and became aware of the importance of developing several crucial competencies as science teachers. The lesson-study approach revealed to be a strategy for learning about teaching planning that has the particularity of bringing theory and practice remarkably closer.

Keywords: Lesson-study; Biology Education; Health Education; Pre-service Teachers' Education.

Introduction

Today, new political, economic and social demands bring new challenges to the exercise of the teaching profession. Being a teacher in the present implies a complex and diverse set of skills, which cannot remain indifferent to pre-service teacher education (Galvão and Ponte 2018). Today's teachers are professionals who (i) reflect on their own practices, (ii) invest in their own professional development, (iii) are autonomous and responsible, (iv) investigate and evaluate their own performance, and (v) work in collaborative teams (Schleicher 2012). Moreover, for the new teachers to become agents of transformation in their schools, new learning scenarios are needed in pre-service training programs that envision this way of being in the profession (Galvão and Ponte 2018).

Lesson-study, as a collaboration-based teacher professional development approach, could contribute to promoting these skills. The main idea is that teachers organically come together with a shared question regarding their students' learning, plan a lesson to make students' learning visible, and discuss what they observe, after a shared observation of the lesson, implemented in a real school context (Murata 2011).

The purpose of this paper is to present an appraisal of a lesson-study implementation with pre-service biology teachers concerning a health education issue, how blood pressure works and how it is affected. The main objective of the research is the analysis of the potentialities of lesson-study as a formative strategy for pre-service biology teachers, and to discuss how these potentialities can contribute to health education teaching.

Lesson-study in pre-service science teachers' education

Thinking about science education today involves taking into account what is essential to a citizen in a complex technology-based society in accelerating renewal and uncertainty.

The skills needed for such a citizen living in the 21st century (AMA 2010) are based on critical thinking and problem-solving capacities, on effective communication, on collaboration, on creativity and innovation.

Science Education research on curriculum critical perspectives affirms that teachers are at the heart of the change. In order to promote a change of perspective in science education, teachers need to develop critical thinking teaching strategies, organize challenging learning environments, give careful support to students' self-regulation and learning, through problem-solving and decision making (Osborne and Dillon 2008).

These teaching demands have profound implications on teachers' new competencies to effectively promote their students' 21st-century skills, and consequently on teachers' education programs. The OECD's comparative review of innovative learning environments concludes that teachers need to be well-versed in the subjects they teach, in order to be adept at using different methods and changing their approaches, to have a rich repertoire of teaching strategies and the knowledge of how and when to use it, and to have a deep understanding, not only, of how learning happens, but also, of individual students' motivations, emotions and lives. Moreover, they need to be able to work in highly collaborative ways, to acquire strong skills in technology and its use as an effective teaching tool, and to reflect on their practices to learn from their experience (Schleicher 2012).

In response to these requests, new pre-service teacher education programs with new designs are needed to provide teachers with opportunities to analyse, reflect and attempt a variety of work situations in a complex social and intellectual context such as schools, with diverse students, from diverse cultures and with multiple previous experiences (Galvão and Ponte 2018). Korthagen et al. (2001) propose a "realistic

approach" as a teacher training model. This approach begins with concrete problems and questions of pre-service teachers about real contexts and it develops through sharing and interaction among all involved (educators and pre-service teachers).

Some studies have, indeed, shown that the involvement of pre-service teachers in the ongoing reflection on classroom experiences, promotes the ability to mobilize the theoretical inputs necessary to understand their own practice (Körkkö et al. 2016). This systematic reflection can be achieved promoting a constant alternation between action and reflection, through a spiral model, engaging pre-service teachers in a continuous and progressive process of professional development.

Lesson-study, as a teacher professional development process based on collaboration and reflection practices, seem to have great potentialities in promoting these skills. Indeed, the focus of lesson-study is to support teachers in thinking about their own students' learning (Murata 2011). According to Lewis (2002), the outcomes of lesson study practices include helping teachers to reflect carefully not only about the goals for a particular lesson, but also about the long-term goals they have for the learning of students. Furthermore, in a systematic review, Ponte et al. (2020) highlighted the results of several studies suggesting that lesson-study may influence the development of teachers' reflective capacity, reinforcing the idea that professional learning depends on teachers' questioning about learning, teaching and classroom practice.

There are some examples of the use of lesson-study in pre-service teacher education (for a review see Larson et al. 2018). According to Larssen et al. (2018), lesson-study has been used in a growing number of contexts to scaffold pre-service teachers for continuing learning, but also to support the development of important teaching skills. The application of this professional development process with pre-

service teachers has been subject to a range of adaptations, in which the level of participation by pre-service teachers in planning, observing, and discussing learning evaluation varies quite markedly, from teaching their research lesson only to their fellow students at the university (Fernandez 2010), to being involved only in planning but without the opportunity to teach (Cavey and Berenson 2005), as the study developed in this work. According to Larssen et al. (2018), the focus of lesson-study, when used as a vehicle for teachers' professional development, has been on how deepening knowledge and understanding of pupil learning can positively affect the efficacy and quality of teaching. When used in pre-service contexts, the focus falls much more on the pre-service teachers themselves, rather than on the learning of the pupils, or on the development of pre-service teachers' awareness of how their teaching impacts upon pupil learning.

Health Education as a multidimensional curriculum subject

Health Education can be defined as ´Any combination of planned learning experiences based on sound theories that provide individuals, groups, and communities the opportunity to acquire information and the skills needed to make quality health decisions´ (Joint Committee on Health Education and Promotion Terminology 2001, 92). Its goal is to foster health literacy, that represents a specific set of cognitive and social skills related to health decision-making – whether this is making best use of health services, adopting healthy lifestyles, or taking an active role in addressing the social determinants of health, and to promote health behaviour, which includes any activity undertaken by an individual, regardless of actual or perceived health status, for the purpose of promoting, protecting or maintaining health (Nutbeam and Kickbusch 2000).

Health literacy implies the achievement of a level of knowledge, personal skills and confidence to take action to improve personal and community health, by changing personal lifestyles and living conditions. Accordingly, because it improves people's access to health information, and their capacity to use it effectively, to solve problems, and induce change, health literacy is critical to their empowerment (Nutbeam and Kickbusch 2000).

The confidence to take action implies the development of action competence as an essential component of health education, empowering students with the capacity to act – now and in the future – and to take responsibility to their actions with reference to health issues (Jensen and Schnack 1997). The concept of action competence is particularly relevant in the context of a democratic approach to education, meaning the ability and willingness to participate through purposeful and intentional actions. Such a goal in the context of a health promoting school is attained through solving authentic and meaningful problems to the student. Jensen (1997) refers to four inter-related components of action competence that students should develop while solving a problem: knowledge/insight about the problem of their concern; commitment and drive toward a solution; visions of what their life, the community and society would improve in relation to the problem; experience of different types of concrete actions leading to the solution of the problem. Action competence in relation to health is one of the values of health promoting schools referred to by Simovska (2012) along with inclusion, democracy, participation and influence, and critical literacy.

In Portugal, according to the Basic Health Act (1990), in which the freedom of choice is recognized, each person is responsible for his/her own health and, consequently, for the health of the community. Each one has a duty to defend and

promote it for the common good and for the benefit of his/her own interests. According to the National Health Plan 2012-2016, increasing the power and responsibility of each citizen to improve individual and collective health is possible through the development of health literacy in a context of empowerment, active participation, and individual involvement. And, because one of the tools for strengthening citizenship and health literacy is formal education, in Portugal, since 2005, Health Education has become compulsory in the Educational Project of every school (from elementary to secondary levels).

In the Portuguese context, according to the health education framework (DGE 2017), health promotion and education in schools is an ongoing process aimed at developing the students' skills, enabling them to confront themselves positively, build a life project and be able to make individual and responsible choices. Although health education is a thematic that is transversal to all curricular units, it must be explicitly explored in the K-12 Science Curricular Unit. In the context of this curricular unit, the concept of health is approached as a relation between the self, the other and the environment, leading to the understanding that quality of life implies health and security in an individual and collective perspective. Students must also understand how the human organism works in an integrated way, learning about basic morphological and physiological aspects of the different systems of the organism. It is also expected students' learning about the behaviours that interfere with the balance of the organism (e.g. regarding alcohol, tobacco, drugs, hygiene, physical activity) being able to assume healthy attitudes and behaviours in the correction of imbalances. The lesson planned in this work falls within the scope of this theme.

Within this context, health education, within science education, can only be reasonable if both knowledge and motivational factors are recognized and reflected

upon health-related decision-making processes, in favour of preventive health behaviours (Zeyer and Dillon 2014).

Description of the Lesson-Study

The lesson-study took place in 10 face-to-face sessions (two hours each) and through autonomous work, in distance learning sessions, using the internet facilities. We had the collaboration of an experienced teacher, used to teach the subject under study, so that the lesson could take place in her 10th grade class of 25 students. She also analysed and gave suggestions concerning the lesson planned by the pre-service teachers. The analysis of the subjects to teach to this class circumscribed the theme to choose, which was related to the blood system of the human body and associated health problems (to be addressed in a 90 min class).

In an initial preparation phase (4 sessions), the pre-service teachers analysed several curriculum guidance documents to understand the curricular framework of the topic. Didactic issues were also analysed, with emphasis on the planning of a teaching unit, on the development of classroom activities, like inquiry and problem-solving activities, and on the ways to support students, namely the type and nature of questions that could orient students' learning. The didactic strategies explored with pre-service teachers were aligned with the science education international reports, concerning the need to develop more student-centred teaching and learning strategies. The discussion of all these aspects was based on articles previously distributed to pre-service teachers and on proposals for planning and development of activities, made by them, in group work.

The lesson-study itself consisted of three different phases (figure 1). In the first phase (4 sessions), the pre-service teachers proposed and planned, in group work, a

lesson about the human blood system and its disorders. The pre-service teachers worked in groups of three to four members (three groups). Each group produced a proposal. The three proposals were discussed by all the class (together with the university educators involved), and based on this joint discussion, a single lesson proposal was drawn up based on the three proposals that had been presented.

- Insert Figure 1 -

The second phase (one session), was the shared observation of the lesson, implemented by the secondary teacher with her students. The observation of the class, by the pre-service teachers, was non-participant, and was guided through a set of prompts, namely: what questions are asked by students to try to understand the tasks? What are their answers to teacher's questions? What errors and/or difficulties are evidenced by students? What strategies students use to accomplish the tasks? In the moments of whole-class discussion, all observers collected data on student behaviour. During the autonomous work (group work), two or three observers (pre-service teachers) were responsible for monitoring one group of students, so there was always more than one observer to each group. Within each group, each observer focused only on two students.

The third phase (one session), was a group discussion about the lesson planned and implemented, focused on its potentialities for students' learning, its limitations, and the potential of this approach to pre-service teachers' professional development. After this discussion, each pre-service teacher was asked to write an individual reflection on the whole process.

Methodology

This research explored the potentialities as a formative strategy of implementing a lesson-study on a health education issue, with pre-service biology teachers. The main research question was: What are the main impacts of the lesson-study on pre-service teachers' didactic knowledge?

Context of the Lesson-Study

The participants were the whole class of the teaching master program 2018/19, 11 pre-service science teachers (8 females and 3 males, between 25 to 27 years old), a secondary school teacher and the three authors as university teacher educators. These pre-service teachers were in the first year, of a two-year Master Course of Teaching Biology and Geology. Previously, the preservice-teachers had taken a degree in Biology and Geology (at least three years). The lesson-study was conducted in the 2nd semester, framed in two curricular units, Initiation to Professional Practice, which includes visits to schools, and Didactics of Biology and Geology, which involves the exploration of different strategies of teaching science.

The lesson proposed by the pre-service teachers, was a problem-based activity, and was centred on four real clinical cases, i.e., cases of people who had high probabilities of suffering a cardiovascular problem, due to their characteristics and life-style. The tasks proposed, challenged students to assume the role of a doctor and to search about the main factors (e.g. physiological, genetic, motivational, way of life), present in each of the four cases, which can cause a cardiovascular problem, and to understand the way each of these factors act in the human body. In the end, they were challenged to think whether all changes, that occurs in our organism along our life, are negative and need medical treatment. This proposal was deepened by the pre-service teachers through autonomous group work, each group being responsible for different

tasks, namely, concrete description of the clinical cases to explore, identification of the scientific content and didactic objectives, given the current curriculum documents, and definition of the guiding questions for the teacher to use during the lesson. In addition, all groups were tasked with deepening the scientific content involved, and listing research sites as a support for the teacher's work and for students' classroom work. Although this work did not occur in face-to-face sessions, it was oriented both by the secondary school teacher and the three university educators, with the support of a Google drive, where all the documents were included.

Data Collection

In this research we followed a qualitative and interpretative approach (Erickson 1986), using field notes of the teaching lesson and of the final group discussion, and individual written reflections for data collection.

In the final group session, for the discussion of the lesson planned and implemented, one of the researchers (one of the university educators), assumed the role of a participant observer, being responsible for writing a description of the session with records of all interventions (field notes)

The individual reflection, written by each pre-service teacher at the end of the whole process (11 reflections, two-pages each), had some orienting guidelines, namely: What did you learn about teaching this curriculum content? What has changed in your perspective about this curriculum content? How this activity contributed to your work as a science teacher? What difficulties did you experience with the development of this approach? What potentialities and limitations do you think this type of approach has for pre-service science teacher education?

For data analysis, from field notes and written documents, we used a method of

content analysis, through an iterative process, of reading and re-reading data, in order to assign categories according to the different meanings present (Miles and Huberman 1994). The field notes were analysed according to the same guidelines used for orienting students to write the reflections (described above), and data obtained from the analysis of both documents were crossed, in order to identify the categories of analysis discussed in the results section. The inductive analysis of the field noes and reflections were performed independently by two researchers, who discussed and reviewed the analysis to achieve a high degree of fidelity between them. The names of the participants are fictitious.

Results

In the course of this training process, it was found that the pre-service teachers developed and deepened, not only, some aspects of didactic knowledge, related to lesson planning, classroom communication, and scientific preparation, but also aspects related to the skills essential to be a science teacher, as collaborative and reflection skills.

Lesson planning

It was clear that this pedagogical approach allowed pre-service teachers to develop a good understanding of the elaboration of lesson plans. The analysis of the field notes revealed that pre-service teachers identified some problems related to time management. Indeed, during the group discussion, they mentioned the fact that they realized very well the importance of managing the different moments of the lesson, and in particular, the importance of organizing the lesson so that there is time for the final discussion of the

tasks carried out (from field notes). The analysis of the written reflections confirmed this result. In their own words:

´I consider that there was a lack of time to address some issues deeply, there was a lack of time to make a more detailed final discussion with the groups at the end of the activity. Considering this, one of the things that would change in the lesson is precisely the number of clinical cases to be analysed and interpreted by the students, becoming only one case.´ (Written reflection; Diana)

Besides, they also mentioned the importance of this final discussion to be sufficiently deep and clear, so that it could function as an organizer of the learnings developed (from field notes). This was further reinforced in the written reflections:

´Also of note is the importance of the detailed lesson planning as a guiding document for the teacher's action. At this stage, the relevance of a clear and rigorous systematization of the lesson, as well as the selection of the appropriate methods to achieve the defined objectives, is clearly visible.´ (Written reflection; Carolina)

Another aspect highlighted during the final discussion session (from field notes) was the need to allocate sufficient time for students' autonomous work, included in the lesson, namely giving them time to understand what to do, to perform it, and to present to others what they have done.

Classroom communication

The analysis of the field notes revealed that one of the most intensively debated aspects was how the teacher would conduct classroom communication, particularly during the

whole-class discussion, and sought to identify the guiding questions that could orient the class, and the best way to connect the different moments of the lesson. After the implementation of the lesson, most pre-service teachers indicated that they had developed a greater sensitivity regarding this aspect, recognizing that the way communication is conducted is essential for students' learning. It was even mentioned that the way the teacher introduces the lesson can be `disruptive or structuring', influencing the rest of the session.

However, after the implementation of the lesson, and despite realizing the importance of having a teacher guidance document, the pre-service teachers realized the impossibility of predicting all situations, pointing out the importance for the teacher to have the ability to react and adjust to the needs of each particular class. As one of the participants said,

´In this study, I visualized the difference between educational intention and educational action. Planning is clearly more than the mere ordering of a set of tasks. It presents an intention, but it will not necessarily correspond to the teacher's action in the classroom. The interaction with the students makes the planning much more dynamic, which besides the content management, involves the management of the unpredictability, as well observed by the school teacher.´ (Written reflection; Carolina)

Regarding the guidelines given by the teacher, aspects related to the importance of giving clear and very explicit indications about the tasks to develop in group were highlighted during the final session (from field notes), as the pre-service teachers realized that not all students understood what they had to do. On the other hand, they pointed out the importance of the teacher giving permanent support to each group, since

his/her presence throughout the work is essential in order to guide the group, and to ensure that it works properly, with the involvement of all its elements.

Scientific preparation

Regarding the scientific knowledge, the main topic of the lesson-study was the human blood system and its disorders. Although the pre-service teachers, that participated in this study, had a degree in Biology and Geology, having the necessary scientific knowledge on this theme, during the course of the lesson-study they faced the need to deepen and update some knowledge, related to the identification of the main factors responsible for heart diseases, and mainly for understanding the way each one of these factors acts on the human body. One of the aspects they faced, when resorting to concrete and real clinical cases, was the fact that all these factors can act in a combined way, which requires a deep understanding of the functioning of the human organism as a homeostatic system. This view of the organism as a whole raised new challenges, triggering the need for pre-service teachers to deepen their scientific knowledge and to integrate these learnings in a real, and as such, extremely complex context.

Another aspect mentioned by all pre-service teachers, during the final discussion session (from field notes) was the increased understanding of the need for the teacher to be very well prepared from a scientific point of view, going far beyond the contents that will be worked in the lesson, and the importance of being always scientific updated. This issue was also present in their written reflections. In their own words:

´I recognize here the importance of proper scientific preparation for updating knowledge, which implies a careful and rigorous selection of specific information and resources to support the teacher. It is worth noting the real perception I had of the time and effort required for this preparation.´ (Written reflection; Carolina)

´This also gave me a better understanding of the difficulty and of all the time needed to prepare a lesson, to be able to organize and pre-dispose to whatever questions the students have, to get as much and detailed knowledge as possible, to know in a comprehensive and detailed way all the topics needed to be addressed.´ (Written reflection; Diana)

Another aspect that was mentioned in the group discussion, was the need for the teacher to transpose the scientific discourse into a didactic discourse, suitable for each group of students (from field notes and written reflections). In the words of a participant:

´Of particular relevance is also the observation of the transposition between the scientific discourse to the didactic-pedagogical discourse. The importance of the pedagogical content knowledge, that is, knowing how to teach the contents, in order to make it more accessible and meaningful to most students, becomes evident here. Particularly, this was one of my biggest difficulties during planning, I couldn't clearly see how this would be done by the teacher and how I would do it. Observing the lesson allowed me to understand how experience is a crucial factor in the development of pedagogical knowledge, and how knowledge of the environment of the class, as well as about the students' characteristics, influence the teacher's practice.´ (Written reflection; Carolina)

So, they showed to well understand the importance of teachers to present a deep scientific and pedagogical content knowledge to guide a lesson in an effective and fruitful way.

Teacher skills: Collaboration and Reflection

Through this experience, pre-service teachers realized the importance of teachers developing some skills throughout their professional life, namely collaborative work, as an essential aspect to improve their own practice:

´I liked the joint planning, as we took advantage of the best ideas that were proposed by all. It was a good lesson in that, as teachers, we will be better professionals if we can work together with other teachers and share activities and experiences with each other.´ (Written reflection; Rita)

´I see this as a way, for me, to learn to open up to teamwork in my working life, to learn to hear opinions different from mine, to ponder practices, to adapt classes to different situations and different partnerships, i.e. a way of being a professional with some flexibility.´ (Written reflection; Leandro)

Another aspect highlighted by preservice teachers was the ability to reflect on their own activity, assuming that it is a very challenging task:

´This ability to reflect on action and improvise in the face of an unforeseen situation, without losing clarity in the explanation, is something I find extremely challenging, especially for early-career teachers… Thus, the awareness that self-

assessment is a strong ally in assessing our performance in teaching practice, becomes essential.´ (Written reflection; Carolina)

´In this context, I consider that I played the role of a researcher of the others' practice, and at the same time, became aware of the importance of researching my future practice to improve the teaching-learning process.´ (Written reflection; Sara)

As highlighted by these excerpts, during the lesson-study, this reflection skill is promoted not only at the end of each lesson, but throughout all the entire process (before, during and after the action), assuming themselves as researchers of their own practice.

In short, and according to pre-service teachers' words, it appears that lesson-study as a formative process turned out to be a process that is,

- Real, because it was implemented in a real classroom, although in a controlled context,

Be able to see the passage from ´writing on paper, through all planning, to the reality that is a classroom, and the real applicability of the lesson planned´. (Written reflection; Diana)

The lesson-study has large potential in pre-service teacher education because it is a smoother passage into the profession. ´Although it was not a pre-service teacher who taught the planned lesson, we felt a huge responsibility in devising and creating a meaningful activity for the students.´ (Written reflection; Paula)

- Enriching, allowing to `be in the middle`, being neither teacher nor student, thus opening new perspectives,

´We put ourselves in the "middle of the action", as it was possible to see both the teacher's and the students' roles.´ (Written reflection; Diana)

´Moreover, although we are part of the action throughout the process, we have never faced the role of the teacher. We were professional researchers because we observed, noted and reflected on the successes and failures, based on the data collected. We thus had a key role in helping to reflect on the proposed task.' (Written reflection; Paula)

- Complete, making a bridge between intention and action,

´We had, as students, the opportunity not only to devise and plan a lesson, to describe the objectives and competences to be explored, but also to observe the results in reality, during the lesson. In analogy, there was a bridge between what we planned, in the conceptual and in vitro realm, and reality - the effective implementation of the lesson. It was the first time we had this opportunity in our course. So far, we were only offered the idealization and planning of lessons, without any contact with the reality of a classroom.´ (Written reflection; Paulo)

In resume, this approach revealed to be very complete as a formative process, involving pre-service teachers in the planning of a lesson that will be implemented in a real, but controlled, context, allowing them to better understand, not only, the role of the teacher, but also, the behaviour of the students.

Discussion

The main goal of this research was to analyse the potentialities of lesson-study as a formative strategy for pre-service biology teachers and, to discuss how these potentialities can contribute to health education teaching.

Considering the first aspect under study, the results showed that this teacher education approach is very rich, concerning the learning opportunities it offers, not only related to the scientific, but also the didactic knowledge of pre-service teachers. These results are in line with other studies conducted both in in-service teachers' education, as well as in pre-service teachers' education (for a review see Larson et al. 2018), who have identified lesson-study as a formative process that allows teachers and pre-service teachers to deepen a set of learnings related to their own practice. Ponte et al. (2020) describe lesson-studies as a form of professional learning that is: experiential, since it draws on teachers' experiences; sustained, with its cycles of planning, predicting, enactment and reflection; grounded, being well resourced and related with context and culture; safe and collaborative, being informed by expertise and research; provocative, involving both pressure and support, and focused on students' knowledge. Aligned with these ideas, our results revealed that the implemented lesson-study, on the one hand, promoted a strong link with practice, since it was developed in an authentic context, with the teacher who taught the lesson. On the other hand, it required the mobilization of scientific content knowledge about the topics covered, and of didactic knowledge about central aspects such as lesson planning, task selection, class management and classroom communication. Finally, it also promoted pre-service teachers' awareness of the skills essential for any teacher to pursue a quality teaching.

Considering its potentialities for health education teaching, this experience seems to have promoted pre-service teachers' ability to analyse their own ideas about

teaching and learning, the flexibility to change, and the awareness of the implications of their behaviour. These capacities are essential to teach science in general, and health in particular, nowadays. Indeed, under the slogan of "Skills in the 21st-century", learning has been thought, in broad and in-depth terms, in the form of problem-solving, so that knowledge can be applied in new and varied situations (Galvão and Ponte 2018).

Based on the results obtained, lesson-study can be assumed as an important component of pre-service science teachers' education courses, providing some important support on the development of challenging learning contexts, based on problem-solving and inquiry activities, like the one proposed and developed in this study. In fact, this requirement to collaboratively plan and have the responsibility to prepare a lesson (which includes understanding the curriculum as a starting point, in-depth knowledge of the content, choosing strategies and materials to use in class) for someone else to teach is a learning that makes this training process distinctive from others. In this process there is an involvement of all participants, generating a deep collaboration in the design of the class, in the observation of the students' work and in collective reflection, making them more attentive to the students, the way they learn and their needs as future professionals. The promotion of didactic development is carried out in an initiation phase of the training of these future teachers, favoring an early professional development and a commitment to the teaching profession.

These capacities are also essential to explore a multidimensional curriculum subject such as a health education issue. The planned lesson developed by the pre-service teachers involved the exploration of a real situation (clinical cases), which as such, are complex cases, involving different interconnected dimensions, related to aspects so diverse as biological factors, emotional factors, and life-style. Indeed, the task proposed was as a problem-based activity, in which students were asked to assume

the role of doctors to solve a real and complex problem. This use of real-life cases seemed to allow students to overcome the simplistic analysis, present in the common sense, for example that wrong food generates strokes, and to address the complexity of the phenomenon in its multiple dimensions, reinforcing not only, the importance of the use of scientific knowledge to address any health issue, but also to discuss the ethical aspects involved, in order to potentiate the understanding of health as a decision-making process. So, it appears that this teacher education experience has enhanced the development of learning related to the teaching strategies adequate to teach a theme as multidimensional as this one.

However, it is clear that this formative experience has its limitations, namely the fact that the pre-service teachers are dealing with a class they do not know, having no direct knowledge of the students who will carry out the planned activity. And this, of course, will be an important aspect that pre-service teachers will need to be aware of in their practice (Galvão and Ponte 2018). One aspect that could improve the process is the early involvement of the school teacher, allowing the pre-service teachers to get to know better the students who will carry out the tasks, so that the proposed strategies could be well-suited to their characteristics. Another aspect is to extend the process a little further, in order to involve the pre-service teachers in the re-organization and improvement of the lesson planned and implemented. And finally, the fact that pre-service teachers did not implement, for their own, the proposed lesson, could have limited some of their learnings, mainly concerning the process of managing and directing the class.

Conclusion

The results of this study indicate that lesson-study implemented during pre-service teachers' courses, can, in fact, give an important contribution to developing science

teachers' capacities and willingness to create challenging learning situations that successfully engage students in problem-based activities, able to promote a greater empowerment to make quality health decisions. Indeed, through this collaborative and on-going process, pre-service teachers had the opportunity to understand all the scientific knowledge needed to teach this theme, but also, all the different aspects involved, being capable of creating a learning situation, that successfully promotes students learning on all the dimensions included in health literacy, such as health care, disease prevention and health promotion. This approach seems to contribute to the need to provide teachers with the knowledge and ability to develop didactic strategies that promote an integrated and more comprehensive approach of health education.

In accordance with Taylor & Francis policy and our ethical obligation as a researcher, we report that there is no potential conflict of interest.

References

AMA 2010. *Critical Skills Survey*, http://www.amanet.org/news/AMA-2010-critical-skills-survey.aspx.

Cavey, L.O. and S.B. Berenson. 2005. "Learning to teach high school mathematics: patterns of growth in understanding right triangle trigonometry during lesson plan study." *Journal of Mathematical Behavior* 24(2): 171-190.

Diário da República n.º 195/1990, Série I de 1990-08-24. *Lei de Bases da Saúde* [Basic Law of the Health System].

Direção Geral de Educação (DGE). 2017. *Referencial de Educação para a Saúde* [Framework for Health Education]. Lisbon: Ministério da Educação- Direção Geral de Educação, Direção Geral da Saúde.

Erickson, F. 1986. "Qualitative methods in research on teaching." In *Handbook of Research on Teaching*, published by Wittrock, M.C. New York: Macmillan.

Fernandez, M.L. 2010. "Investigating how and what prospective teachers learn through microteaching lesson study." *Teaching and Teacher Education: An International Journal of Research and Studies*, 26(2): 351-362.

Galvão, C., and Ponte, J.P. 2018. *Práticas de Formação Inicial de Professores: Participantes e Dinâmicas*. Lisboa: Instituto de Educação da Universidade de Lisboa. ISBN: 978-989-8753-42-7

Jensen, B. 1997. "A case of two paradigms within health education." *Health Education Research* 10(4): 419-428.

Jensen, B, and K. Schnack, 1997. "The action competence approach in environmental education." *Environmental Education Research* 3(2): 163-178.

Joint Committee on Terminology 2001. "Report of the 2000 joint Committee on Health Education and Promotion Terminology." *American Journal of Health Education* 32(2): 89-103. doi: 10.1080/19325037.2001.10609405

Körkkö, M., O. Kyrö-Ämmälä, and T. Turunen, 2016. "Professional development through reflection in teacher education." *Teaching and Teacher Education* 55: 198-206.

Korthagen, F.A.J., J. Kessels, B. Koster, B. Lagerwerf, and T. Wubbels. 2001. *Linking practice and theory: The pedagogy of realistic teacher education*. Mahwah: Lawrence Erlbaum Associates.

Larssen, D.L.S., W. Cajkler, R. Mosvold, R. Bjuland, N. Helgevold, J. Fauskanger, et al. 2018. "A literature review of lesson study in initial teacher education: Perspectives about learning and observation." *International Journal for Lesson and Learning Studies* 7(1): 8-22.

Lewis, C.C. 2002. "Does lesson study have a future in the United States?" *Nagoya Journal of Education and Human Development* 1: 1–23.

Miles, M.B. and A.M. Huberman. 1994. *Qualitative Data Analysis An Expanded Sourcebook*. Thousand Oaks, CA: Sage Publications.

Murata, A. 2011. "Introduction: Conceptual overview of lesson study." In *Lesson study research and practice in Mathematics Education*, published by Hart, L.C. et al. NY: Springer.

Nutbeam, D. and I. Kickbusch. 2000. "Advancing health literacy: A global challenge for the 21st century." *Health Promotion International* 15(3): 183-184.

Osborne, J. and J. Dillon. 2008. *Science Education in Europe: Critical Reflections*. London: King's College London, The Nuffield Foundation.

Ponte, J.P., G. Ware, and M. Quaresma. 2020. "Lesson study as a learning context in Mathematics education." In *International Handbook of Mathematics Teacher Education: Volume 3(2nd Edition)*, published by Lloyd, G.M. and O. Chapman. Brill/Sense. doi: 10.1163/9789004419230_005.

Schleicher, A. 2012. *Preparing Teachers and Developing School Leaders for the 21st Century: Lessons from around the World*. OECD Publishing. doi: 10.1787/9789264xxxxxx-en

Simovska, V. 2012. "What do health-promoting schools promote? Processes and outcomes in school health promotion." *Health Education* 122(2): 84-87.

Zeyer, A. and J. Dillon. 2014. "Science|Environment|Health—Towards a reconceptualization of three critical and interlinked areas of education." *International Journal of Science Education* 36(9): 1409-1411. doi: 10.1080/09500693.2014.904993

Figure 1. Organization of the lesson-study.