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## The role of leadership in a STEM teachers professional development programme

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### Abstract

The international academic community recommends the integration of Science, Technology, Engineering and Mathematics (STEM) education in order to better prepare students to face the increasing challenges of our real world. However, literature diagnoses difficulties related to the implementation of STEM integrated tasks by the teachers in school, related to the need of having enough specialised knowledge to achieve this goal. Teachers are the key to any process of a pedagogical intervention. In this regard, there is the need to promote their professional development, which raises the following question: What strategies of a professional development programme (PDP) provide teachers with motivation and confidence to innovate their practices? This paper discusses the role of leadership as an important strategy to promote the efficacy of a STEM PDP. With a qualitative methodology and an interpretative approach, a primary school teacher case study is presented. The teacher was able to develop STEM integrated tasks in the context of a collaborative network involving the team's project leader, the school leaders and the training centre leader.

**Keywords:** Collaboration, leadership, primary school, professional development, STEM.

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## 1. Introduction

There is an international agreement on the importance of promoting Science, Technology, Engineering and Mathematics (STEM) education to meet the growing need of professional careers in these areas (e.g., English, 2017; European Schoolnet, 2018). For this reason, the international academic community recommends the integration of subject matters related to STEM in order to better prepare students to face the increasing challenges of the real world (Baker & Galanti, 2017; Rocard et al., 2007). However, the literature diagnoses difficulties related to the implementation of STEM integrated tasks by teachers, especially at the primary school level, related to the need of having enough specialised knowledge to achieve this goal (English, 2017; Kim & Bolger, 2016; Riordain, Johnston & Walshe, 2016). In fact, teachers are the cornerstone of any process of innovation (Rocard et al., 2007) and no curricular reform is possible without their professional development (Hewson, 2007). For this reason, in order to innovate teachers' practices, there is the need to provide an adequate Professional Development Programme (PDP) that gives them knowledge and skills to achieve the desired goals. In this regard, literature presents some studies identifying strategies that promote the efficacy of teachers' PDP (e.g., Darling-Hammond, Hylar, Gardner & Espinoza, 2017; Desimone, 2009). In this study, we intend to highlight the role of leadership as an important strategy to promote the efficacy of STEM teachers' PDP. With this aim, our research question is: What is the role of leadership in a teachers' PDP intended to promote the implementation of STEM hands-on tasks in class?

In this paper, we start by presenting the literature review and theoretical framework. Next, we describe the context of the study, which is based on a broader pedagogical intervention project targeted to promote STEAMH (Science, Technology Engineering, Arts, Mathematics and Heritage) education (Costa & Domingos, 2018a). The following sections concern methodology, data analysis and discussion based on an empirical study that includes primary school teachers participating in a PDP related to STEM integration. Finally, conclusions are presented.

## 2. Literature review and theoretical framework

Despite international efforts and reforms to promote STEM education, many authors still argue it is a challenge to concretise this goal, especially at the primary school level (Breiner, 2012; Osborne & Dillon, 2008). A possible explanation for this challenge is related to the need for a robust Content Knowledge about the subject matters to integrate by teachers (English, 2017; Kim & Bolger, 2016). For this reason, it is crucial to provide teachers with a PDP that leads them to gain knowledge and skills to achieve the desired goals. In this regard, it is necessary to develop adequate PDP (Desimone, 2009), including workshops in a collaborative learning environment, where teachers can practise what they are expected to implement in the classroom (Afonso, Neves & Morais, 2005). Also, to facilitate an integrative approach to the teaching and learning of STEM, there is 'a need to ensure that the teachers are given an opportunity to acquire knowledge of the content of the mathematics and science lessons' (Riordain et al., 2016, p. 248). With this in mind, the same authors argue that: 'supporting the teachers at school level [...] is a major contributing factor to the successful implementation of the integrative approach' (p. 248). Finally, a PDP will only be successfully achieved if teachers gain the skills to implement what they learned in the classroom (Buczynski & Hansen, 2010).

In what concerns teachers' professional development, Desimone and Garet (2015) present a conceptual framework for effective professional development. According to them, there are at least five features that need to be in place: (a) content focus: activities that are focused on subject matter content and how students learn that content; (b) active learning: opportunities for teachers to observe, receive feedback, analyse student work or make presentations, as opposed to passively listening to lectures; (c) coherence: content, goals and activities that are consistent with the school curriculum and goals, teacher knowledge and beliefs, the needs of students, and school, district, and state reforms and policies; (d) sustained duration: PD activities that are ongoing throughout the school year and include 20 hours or more of contact time and (e) collective participation: groups of teachers

from the same grade, subject or school participate in PD activities together to build an interactive learning community (Desimone & Garet, 2015, p. 253). However, the same authors state that it is not clear how to translate the five general features into effective practice and, for this reason, more studies are needed.

It is up to the schools, and consequently to the teachers, to guide the students to achieve the knowledge that a country considers important for them to acquire (Young, 2007). This author calls powerful knowledge to this specific type of knowledge that integrates the school curricula. In order to provide the students with this knowledge, it is necessary to develop a collaborative work with teachers and researchers (Young, 2007) which promotes the integration of tasks in class with an adequate pedagogical approach (Geiger, Goos, Dole, Forgasz & Bennison, 2014). From this point of view, it is crucial to create a network that motivates and supports teachers during their professional development (Hewson, 2007; Rocard et al., 2007).

It is in the context of this collaborative network that the school leaders have an important role to play. In this sense, research shows that leadership in schools is crucial to contribute to the efficacy of teachers' PDP. In fact, it is much more likely that the teachers will use the ideas and strategies of a PDP when they are aligned with the priorities of the respective leaders (Desimone & Garet, 2015). With this aim, several recommendations are provided. For example, school leaders should provide teachers with time 'to participate in and practice what is learned in the PDP. Further, they can also play a role in including the PDP activities in the evaluation of the teachers' (p. 257). Finally, the district and school leaders' support and enthusiasm in teachers' motivation for PDP is crucial to develop their ability and willingness to innovate their practices.

However, given the multiplicity of PDP, with many different contexts and goals, 'it is difficult to draw conclusions about which factors contribute to the success or failure of PD efforts' (Desimone & Garet, 2015, p. 259). For this reason, it is necessary to develop more studies to understand what are the characteristics of effective PDP.

### 3. Context of the study: the STEAMH project

The Academy of Science, Arts and Heritage (AcademySAH) is a pedagogical intervention project that focuses on establishing a constructivist approach of knowledge of primary school students, with the supervision of higher education teachers from a polytechnic institute of Portugal (Costa & Loureiro, 2016). Since 2013, the AcademySAH (<http://www.academiacap.ipt.pt/>) promotes the design of hands-on experiments and prototypes to enhance the participants' interest in STEAMH learning (Costa & Domingos, 2018a). In addition to activities performed during primary school children's holidays at the laboratories of the polytechnic institute, it also provides teachers Continuing Professional Development Programmes (CPDPs). With the collaboration of a teachers' training centre, two CPDPs were proposed and approved by the Pedagogical Scientific Council of Continuing Education, which is responsible for the accreditation and evaluation of these programmes in Portugal. The first one was proposed in 2015 and consists of a 26-hours face-to-face course with university educators (Table 1).

**Table 1. Topics of teachers' workshops, 2015/2016 school year**

<b>Workshops</b>	<b>Participants</b>	<b>Duration</b>
Mathematics & science: an experimental approach	14	4 hours
Energy for all: doing maths in nature	13	3 hours
Discover the mysteries of sound	14	3 hours
MiMa: mathematics in the making	12	4 hours
Astronomy	13	3 hours
Math and science web free games	13	3 hours
Creative robotics	12	2 hours
Day to day challenges with units	13	2 hours
Methodologies and sharing of good practices	13	2 hours

Based on the experience of the previous course, a second CPDP was proposed in 2016 including a 13-hours face-to-face course and another 13 hours of autonomous work by the teachers with their students (Table 2).

**Table 2. Topics of teachers' workshops, 2016/2017 school year**

Workshops	Participants	Duration
STEM for all: doing maths in nature	38	3 hours
Technologies to promote STEM learning	39	3 hours
Discover the mysteries of sound	37	2 hours 30 minutes
Discover the mysteries of electricity	38	2 hours 30 minutes
Methodologies and sharing of good practices	38	2 hours

The goal of the CPDP is to introduce cross-cutting methodologies focused on teaching and learning science in a laboratory environment promoting interdisciplinarity and using the inquiry method. Interdisciplinarity is mainly related to STEM, STEAM or STEAMH integration.

The CPDPs are organised on several workshops, with a duration of 2–4 hours with science topics such as astronomy, electricity or sound, among others, which occur for a whole school year (from October to June) and are supervised by university educators. In these workshops, teachers have the opportunity to learn, observe, reflect and practice what they are expected to implement in their classroom. Teachers are asked to implement hands-on experiments with their students and to promote their autonomy by proposing their own interdisciplinary tasks. This CPDP has the particularity of supporting the teachers in their classroom either to exemplify interdisciplinary hands-on experiments either to help or observe the teachers in the implementation of their own tasks. At the end of each CPDP, teachers present a portfolio with a critical account of the training context and evidence of interdisciplinary tasks implemented by them in the classroom. So far, about 90 teachers of 15 primary schools participated in the CPDP, from 2015/2016 to 2017/2018 school years, aged 35–61 years and more than 10 years of teaching experience.

The CPDP includes characteristics of effective professional development identified in literature (e.g., Darling-Hammond et al., 2017; Desimone & Garet, 2015) because it includes sustained duration and collective participation, and promotes a collaborative learning environment that supports the teachers during their training. This support is extended to teachers' class, either to develop STEM hands-on experiments with their students or to observe the teachers in action when implementing their own activities.

#### 4. Methodology

In this paper, we use a qualitative methodology with an interpretative approach (Cohen, Lawrence & Keith, 2007). Data collection consists of participant observation and portfolios written by the teachers. Participant observation takes place in the workshops targeted to the teachers and at their classrooms (to support or to observe them in action). When necessary, some semi-structured interviews are carried out to better interpret the case. Also, one case study will be presented. According to Yin (2005), a case study is an empirical investigation that looks at a contemporary phenomenon within its real-life context allowing a generalisation of the obtained results.

Participants in this study are two school leaders, the head of the teachers' training centre and primary school in-service teachers who were involved at least in one of the CPDPs that occurred during the school years 2015/2016, 2016/2017 and 2017/2018. To preserve the participants' identity, all the presented names are fictitious. The school leaders were Carlota (58 years old) and Francisca (54 years old). The head of the training centre was Albertina (59 years old). In particular, one case study about teacher Marta will be presented to highlight how she developed STEM integrated hands-on

tasks in her class in the framework of the collaborative CPDP. She participated in the CPDP for two school years (2016/2017 and 2017/2018). In the school year 2016/2017, she was 50 years old, had 28 years of service and was in charge of a third-grade class with 20 students.

## **5. Data analysis, results and discussion**

In this section, we begin by analysing the first CPDP (Table 1) that occurred in the school year 2015/2016. Next, we analyse the second CPDP (Table 2) that occurred in the school years 2016/2017 and 2017/2018. Finally, we present the teacher Marta's case study to highlight the context that gave her knowledge and skills to develop STEM hands-on tasks in her class.

### **5.1. The pilot project: school year 2015/2016**

To design and implement the CPDP, it was necessary to make a diagnostic of local school needs. In this regard, the head of the AcademySAH (from now on called facilitator) developed a partnership with universities and the local community. In the first stage, several meetings were promoted with one school leader (Carlota) and the head of a teachers' training centre (Albertina). After several discussions, it was decided to initiate a pilot pedagogical project with primary school teachers by promoting their professional development. With this purpose, the facilitator gathered a group of university teachers, usual collaborators of AcademySAH, to conduct the workshops of the CPDP. The participants in the pilot project were a group of teachers from Carlota cluster of schools, who accepted the challenge of participating in this pedagogical intervention. Carlota was responsible for disseminating the training to the teachers, and teachers, who agree to participate, made their inscription in the training centre.

During the whole school year, Carlota and Albertina participated in several workshops of the programme. Also, several meetings occurred to coordinate and organise the activities. For example, the choice of the first classes to perform hands-on experiments by the teachers' educators was coordinated by Carlota. These visits started in October 2015. Alcina was one of the first teachers to be nominated by Carlota to host one of the educators in her class. In the workshop, that took place on the eve of this visit (11/19/2015), the teacher stated that: '[...] these things in science don't interest me. My favorite area is Portuguese'. During the visit, the educator developed an astronomy session using the software Solar Walk and invited the students to find celestial bodies. He also asked the students to solve some mathematical problems related to this matter. Since this was the first intervention in the schools, Carlota and Albertina made a point of attending the entire session. In fact, this was a pilot experience in which both agreed to participate and, as such, sought to be aware of the activities developed and to assess their impact on teachers and students. After the session, the facilitator conducted informal interviews with both Directors. They praised the trainer's communication skills and how he developed mathematical tasks in an innovative way.

Carlota and Albertina recognised that the pilot experiment was adequate and important to the school needs. For this reason, they invited the facilitator to share this experience at the Regional Education Seminar, which is an annual conference targeted for the whole community. In this conference, the pilot experience was disseminated and, following this, two principals from two other clusters of schools asked to join the project in the following school year.

At the end of this school year, a focus group was performed with Carlota, Albertina and all the teachers who participated in the PDP. Everyone recognised the importance of conducting STEM hands-on activities in class. Teacher Alcina, who initially expressed some distrust about the importance of carrying out practical science activities, was one of the most popular interventionists in the focus group:

This is important! My students will never forget that educator-led astronomy class [...] while learning astronomy, they also learned math [...] This training served to realize the importance of conducting experimental activities with my students. (Alcina, Focus, June 2016)

One of the focus group objectives was to make a reflection on the adequacy of the CPDP and what needed to be improved in the next school years. Also, the focus group aimed to prepare the next CPDP, namely choosing the topics and strategies that were considered most relevant to implement in the next programme (Table 2).

### **5.2. The second CPDP: school years 2016/2017 and 2017/2018**

In the school years 2016/2017 and 2017/2018, other three school leaders choose the CPDP (Table 2) to recommend to their teachers. Two of the schools clusters (directed by two school leaders) were referred to as developing 'little systematic and sequential experimental practice across the three levels of education', which are the first (6–10 years old), second (10–12 years old) and third (12–15 years old) cycles of primary school. This is 'one of the weaknesses pointed out by the General Inspectorate of Education and Science report [...] in relation to this Group of schools' (Marina, Final Report, 2018). For this reason, both school leaders decided to change this scenario by implementing STEM projects with a partnership with the AcademySAH and the teachers training centre. The project was included in the National Program for the Promotion of School Success and, therefore, was financed by European funding (POCH-04-5267-FSE-000042).

In this subsection, we highlight Francisca because she was one the most interventive of the four school leaders in what concerns collaboration with the facilitator. In June 2016, she participated in a meeting with the facilitator and Albertina in order to prepare the next school year. She was at the conference of dissemination of the pilot project in March 2016, but she wanted to understand better how to collaborate in order to prepare her teachers and the school to join the project. Her cluster of schools was included in the report that referred 'little systematic and sequential experimental practice [...]', and for this reason, she also chose the same training programme. The following teachers belong to the schools' cluster of Francisca.

Teacher Ivete participated in the PDP for two school years. In the reflection from her portfolio, she referred that: 'I was encouraged by the Director of my School Group to enroll in this training' (Ivete, June de 2017). In fact, this encouragement is because Francisca chose this project to the strategic plan of Learning Quality Improvement in her cluster of schools. This attitude is related to the effectiveness of professional development, as teachers should feel that their interests are aligned with their leaders' priorities (Desimone & Garet, 2015). Also, it is clear that both the Principal and the teacher recognise the need for training in this area and therefore to participate in this training program, which is crucial for the teacher's motivation. In addition to the encouragement of Francisca, the teacher expresses interest in the contents of the programme:

I had great expectations about this training action, not only because the subject interested me a lot [...] but also by the accompaniment of the students by the educators that I knew it was going to be done in class. (Ivete, 2017)

In addition to her interest in the CPDP, Ivete reveals expectations related to the follow-up by the trainers that she already knew she would receive. In fact, in the meeting with Francisca, this support by the educators was discussed and she transmitted this information to the teachers. This reflection reveals the importance of leadership on the one hand by the school leader and on the other hand by the facilitator because of coaching the teachers during their training. After participating in the CPDP, her initial expectations were matched:

I rate this training action as excellent because, within the chosen themes, could not have been better. The fact that it took place for a few months made it possible for us to put into practice what was being said at the face-to-face sessions. (Ivete, 2017)

In addition to classifying this programme as 'excellent', Ivete calls attention to sustained duration which is one of the characteristics of effective professional development. In fact, the formative context, namely, the type of exemplary practices, was considered interesting and appropriate by teachers:

This training was interesting and appropriate, practical work has been developed throughout the various sessions, whose diverse themes are very appealing, meeting the Strategic Plan of our schools as well as the current needs of teachers in the experimental work to be carried out with our students. (Alberta, 2018)

In the school year 2017/2018, the facilitator and Albertina organised a conference, targeted to the whole academic community, in order to publicise the project. In this conference ([http://www.academiacap.ipt.pt/pt/eventos/o\\_que\\_ja\\_fizemos/168/](http://www.academiacap.ipt.pt/pt/eventos/o_que_ja_fizemos/168/)), teachers presented the work they developed with their students in the framework of their participation in the CPDP. School leaders participated in a panel discussion about the impact of this project on the teachers. In this panel, all school leaders recognised the importance of this intervention in their schools. Two of them argued that they chose this CPDP as the strategic project of their schools to face the lack of performing hands-on science experiments by primary school teachers. Finally, they state that: 'After participating in this programme teachers innovated their practices by developing several hands-on experiments'. For example, Francisca defended this measure as a promoter of school success and one of the videos about this initiative is on the website of the Ministry of Education (NSSPP, 2018). The head of the training centre mentioned that 'the main contribution of this CPDP are visits to teachers' classrooms to perform hands-on experiments' because they provide more support to the teachers. In her opinion, these visits distinguish this CPDP from the other ones available at her training centre. Teachers who participated in this conference referred, in their final reports, that 'the sharing of practices in the conference' gave them interesting ideas of new very suitable tasks to implement in the classroom.

In the above reflections, we can find several dimensions. On one hand, the importance of the partnership that was developed among universities (through the educators responsible for the conduction of the CPDP workshops), teachers' training centre (responsible for the coordination of the CPDP) and clusters of schools (with the school leaders and the teachers, who are the targeted public). On the other hand, in the framework of this partnership, leadership is crucial to achieve the desired goals. As discussed earlier, the role of the school leaders was crucial to motivate teachers in a first stage to participate in the CPDP, and in a second stage to keep motivating them to innovate their practices in class. In this second stage, the facilitator and the educators' support were essential to achieve the aims of the CPDP. Next, we exemplify this context with teacher Marta's case study.

## **6. Teacher Marta case study**

After participating in the first two workshops, dedicated to astronomy, in January 2017, Marta presented very interesting proposals of interdisciplinary tasks to be implemented with her students. For this reason, the facilitator asked Marta to accompany her, either by helping to organise and implement her lessons or by observing her classes while she implemented the tasks. Teacher Marta accepted the challenge and appreciated the support proposed by the facilitator: 'I highlight all the interest and support of the trainers during classroom implementations' (Marta, Final report, June 2018). Also, her school leader (Francisca) was very enthusiastic with this project and accompanied the work developed by the educators and her teachers, namely by observing the classes.

In the first school year (2016/2017), Marta developed a total of five lessons. For example, in the fourth lesson, Marta started by showing a video to the students. Next, she performed the Solar System (SS) modelling, in her classroom, by giving her students a script with information about the tasks, and

tables with the diameters of the planets and the Sun, the distance of planets from the Sun and velocity, among others. The Sun with 0.5 m in diameter was drawn with a compass on a yellow card and then cut with scissors. The bigger planets were drawn on a paper and painted with a colour pencil, according to the information on the script. The smaller planets were made with plasticine. Next, planets were placed according to the distances to the Sun indicated in the script (Figure 1). The following excerpt from a dialogue shows how she conducted the tasks modelling:

Teacher: Let's start by building the larger planets. Which ones are they?

Student 1: They are Jupiter and Saturn.

Teacher: What is its diameter?

Student 1: I don't know!

Teacher: Look at the table on the sheet that I gave you

Student 1: Oh! The Jupiter is 6 cm and Saturn is 5 cm.

Teacher: How big is the diameter? [The teacher draws a circle on the board and traces the diameter of the circle.]

Teacher: If Jupiter is 6 cm in diameter, how much will we open the compass? Jupiter is on the paper. How much will we open the compass?

Student 2: 6 cm.

Teacher: No! 6 cm is the diameter. [the teacher returns to the board to explain what is the diameter] Oh Carolina, if you're going to trace the circumference, how much will we open the compass? The size of the diameter?!

Student 2: The radius! It is 3 cm.

Teacher: Very well!



**Figure 1. Students modelling the SS using plasticine and simple drawings**

The abovementioned dialogue is an example of how Marta integrated STEM tasks. In the interviews, performed after participant observation during the classes dedicated to the modelling of the SS, Marta revealed that she designed the tasks with the objective of working different subject matters such as science, mathematics, plastic arts and technology, among others. According to school syllabus, she introduced numbers in the order of millions at her class and she wanted to apply this concept with astronomy. Also, she wanted to perform measures with a rule and the compass that she introduced the week before implementing the activities.

In order to prepare her lessons, about 'Modelling the Solar System', Marta used information that she learned in the astronomy workshops and, also, she used Internet resources to find information about the Sun and the planets' diameters, orbital radius and velocity around the Sun. Also, in the classroom, she used internet resources, such as videos, to promote students learning about the SS. In Table 3, we summarise contents related to the STEM-performed tasks.

**Table 3. STEM contents of the tasks implemented by teacher Marta**

Science	Technology	Engineering	Mathematics
SS	Computer Internet Video Wikipedia	Planning, designing and performing the SS modelling. Drawing and painting the Sun and the bigger planets. Modelling the smaller planets with plasticine.	Working relative scale, distances and sizes. Rotational and translational motion.

At the end of the school year 2017/2018, Marta and other teachers from the other three clusters of schools presented their work in the referred conference targeted to all the academic community. In this conference, her students performed a theatre representing the SS and children’s parents participated in the audience. The team’s project, namely, the school leaders, the head of the training centre and local municipality authorities participated in this conference.

In her final report, Marta recognises that she gained Subject Matter Knowledge related to astronomy and mathematics, and also Pedagogical Knowledge to implement her practices in class:

[...] I have to emphasize new knowledge that I have acquired in relation to some characteristics of the Earth, mathematical notions, historical events and pedagogical theories. (Marta, Final report, June 2017)

She also refers to the promotion of interdisciplinarity between several subject matters:

[...] the activities I developed with my students were related to all the subject matters: Mathematics, in the fields of Numbers and Operations, Geometry and Measurement and Organisation and processing of data; Portuguese, in the construction of texts; Expressions with regard to modelling and painting; Study of the Environment, where it was approached programmatic contents related to the SS and ‘The Discovery of Materials and Objects’ and Citizenship, which aimed to contribute to the formation of responsible and autonomous citizens [...] (Marta, Final report, June 2017)

In summary, teacher Marta recognised that she gained knowledge related to astronomy and mathematics and was able to perform several interdisciplinary tasks related to the school syllabus. In this regard, the support provided by the facilitator and her school leader was essential to achieve these results.

## 7. Final considerations

This paper is based on an empirical study that occurred for three school years and was framed on a CPDP, targeted to primary school teachers, aimed to lead them to implement STEM hands-on tasks in class. In this regard, a network was created with university teachers, school leaders and the head of a training centre, in order to motivate and support the teachers in their professional development (Hewson, 2007; Rocard et al., 2007). This context is in line with strategies that promote the efficacy of a PDP as stated by several authors (Darling-Hammond et al., 2017; Desimone and Garet, 2015).

This research contributes to literature by discussing the role of leadership in a CPDP focused on STEM education. In this context, we verified that the CPDP strategies were aligned with the priorities of the respective leaders, who collaborated in the programme and contributed to motivate their teachers to participate. Furthermore, during the CPDP, school leaders accompanied the programme and recognised the importance of the CPDP to innovate teachers’ practices. This was verified, for example in the panel discussion of the conference when they recognised improvements in the STEM hands-on tasks developed by the teachers.

Based on our research, we verified that school leaders were responsible to motivate teachers to participate in the CPDP, as referred by Ivete: ‘I was encouraged by the Director of my School Group to enroll in this training’ (Ivete, June de 2017). Also, the school leaders participated in meetings with the

facilitator and activities promoted by the team of educators such as workshops (e.g., focus group), visits to teachers' classrooms or the conference targeted to the whole community. They participated in the conference and defended the project as effective for their clusters of schools. Some of them referred that: 'After participating in this programme teachers innovated their practices by developing several experiments'. For example, Francisca defended this initiative as a promoter of her school success and the respective video is on the website of the Ministry of Education (NSSPP, 2018).

The head of the training centre also played a key role in this network. She collaborated with the facilitator to design and implement the CPDP, to select the teachers who made their inscription on the programme and to evaluate them. She, also, invited the facilitator for the conference of dissemination of the project and helped to organise the final conference of sharing of good practices among the teachers who participated in the CPDP, with the aim of publicising the tasks developed by the teachers in class to motivate more teachers to follow their example.

Finally, the facilitator (head of the AcademySAH) was responsible to develop the network and to coordinate the programme with the teacher educators, school leaders, the head of the training centre and the teachers who participated in the CPDP. We argue that this partnership contributed to the efficacy of the training programme as sustained by several authors (Desimone and Garet, 2015; Hewson, 2007; Rocard et al., 2007).

We conclude that leadership plays a critical role in teachers' professional development as an important strategy to promote its efficacy. This leadership includes the team's project leader, the school leader and the teachers' training centre leader.

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