ASSESSMENT *FOR* LEARNING IN SCIENCE EDUCATION: IMPROVING TEACHERS' ASSESSMENT PRACTICES THROUGH A VIRTUAL LEARNING COMMUNITY

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Abstract

This paper aims to present and discuss our PhD project. This project emerged through the data collected in our Master's study (2006-2009) and through our professional activity as science teacher trainers that allowed us to observe that primary education teachers have difficulties assessing the learning outcomes achieved by students.

This study aims to develop resources to help and give tools that allow teachers to improve their assessment practices, capable to respond to their own needs, constraints and fears and, on the other hand, improve students' learning in science education. To design this PhD project, we aim to develop four different phases: *(1)* systematic literature review about assessment for/of learning and defining the state of the art about the studies in assessment of student learning that were performed in the last twenty years in Portugal; *(2)* design, produce and validate resources to implement a teacher training program on assessment of student learning; *(3)* implementation of a teacher training program through a virtual learning community and *(4)* reflect, discuss and assess the teacher training program and the potential of virtual learning communities on the teachers' assessment practices.

Based on the evidence gathered from the above referred studies, and the importance attributed by the former Portuguese government (2010) in skills development, through the emergence of the Basic Education Learning Goals Program (learning goals as evidence of performance skills that students should manifest at the end of each cycle), thinking of new teacher training scenarios through virtual learning communities has become crucial in the Portuguese context.

Taking into account the importance of finding new ways to reflect and act about assessment for learning across new scenarios of teacher training that should promote collaboration between them, our PhD project aims to contribute towards teachers' professional development, through the (re)construction of practice knowledge in this area.

Key-words: Science education, assessment for/of learning, teacher training, virtual learning communities.

1. INTRODUCTION

In a society that is in a constant economic, social and scientific transformation, citizens are required to make reflected decisions based on new currents of knowledge, and values of a democratic nature. These demands require new ways of working, producing, thinking and even learning. This awareness of lifelong learning should begin in the early years, and teachers have a special role in motivating and engaging children with learning skills on how to learn. Science Education should follow this tendency, and teachers should be able to promote contextualized real world student experiences, resorting to daily-based strategies.

The existence of a deficit assessment culture, as well as a reductive comprehension of the concept, that has its origin on an education system with a poor tradition in assessment for student learning (Roldão, 2008) leads teachers to confuse concepts such as assessment and classification, using evidence collected in a symbolic way (Ferreira, 2007; Harlen, 2006).

When we focused our study on the research that was developed in Portugal in the last twenty years about assessment of student learning (primary and secondary schools), we found that it was only in the last six years that researchers and teachers started paying attention in a more significant way to the need of studying this area (Fernandes, 2008, 2009, 2011; Martins, 2008). Between 1994 and 2008 one hundred and thirty master dissertations and eight PhDs were developed.

The results achieved in both academic degrees showed that (Fernandes, 2009; 2011):
a) teachers don't use formative assessment in their practices;
b) teachers don't use different techniques and instruments to assess their students;
c) assessment is only used to certify learning outcomes;
d) teachers' practices and conceptions are influenced by the school assessment culture;
e) the object of assessment is just knowledge, and this is assessed through written tests;
f) there is an absence of a critical and reflected vision from teachers about assessment of student learning in science.

Fernandes (2009) concluded that all the studies referenced above exhibit limitations. From this point of view, he concluded that almost all studies collected data about conceptions and teachers' practices through the analysis of their own speeches (interviews or questionnaires), not valuing real assessment environments. In this context, for further research, the author recommends the need to improve teachers' initial and continuous training.

Assuming that the main goal of assessment is the regulation of the teaching and learning process (Sanmartí, 2007), it becomes fundamental that teachers start to use a different range of techniques and assessment instruments, that allow for a more consistent and reflected communication between students, teachers and the educational community. Formative assessment is taken in this study as the main form of assessing students' learning (Bill no. 6/2010), and according to Bennet (2011), Black (2003), Briggs (2009), Galvão *et al* (2006), Harlen (2006), and Shavelson (2008), it is an integral part of the teaching and learning process, characterized as a continuous, intrinsic, systematic, subjective and prescriptive process, that aims to regulate the teaching and learning process, certify learning outcomes and promote the improvement and quality of the educational system. For this, using assessment as a tool to support and regulate the teaching-learning process means that students take on an active role in those dynamic learning environments, knowing what they are learning, what

they are expect to learn and detect their own difficulties, allowing them to explore the following steps of their own learning.

According to the latest evidence gathered in Portugal about assessment in science education (Rodrigues, 2011; Silva, 2009) and as teacher trainers of the Program on Experimental Sciences Teaching at the University of Aveiro, teachers have difficulties in managing classroom assessment that doesn't take advantage of a diversified range of assessment techniques (such as observation, testing, inquiry or analysis) and instruments (classification or check lists; descriptive narration; questionnaires; interviews; portfolios; written tests). If they have difficulties in using these techniques/instruments the more difficulties they have in planning and developing them. The results obtained by studies in this area (Moreira, 2009; Silva, 2009) show that teachers use written test as the main source of gathering evidence of students' learning, focusing those assessments in science concepts, not valuing science attitudes or science procedural skills.

Assessment should be reflected upon by teachers and investigators in such a way that both can work together trying to improve students' science skills and scientific literacy. In Portugal there is a lack of reflection on and sharing of science assessment instruments, it being indispensable for teachers the dissemination of online tools that allows them to integrate a reflexive, collaborative and learning community, where they can share concerns, questions and discussions.

Based on the theoretical background defined above, our study aims to:
a) Develop (design, produce, implement and assess) a teacher training program on assessment of student learning in science;
b) Develop (design, produce, implement and assess) a virtual learning community that provides teachers with an environment for reflection and discussion about their assessment practices.

Taking into account these objectives it is our goal to answer, at the end of our study (February 2015), a few questions that are divided into two distinct groups: In the first group we are concerned with the assessment of **conceptions and practices of science teachers** and it is our main goal to answer the question:
i.1 Is there a relationship between teachers' conceptions and their classroom practices?
In the second group of questions we are concerned with **teacher training strategies**, our objective being to answer a question such as:
ii. What is the impact of attending a training program about assessment of student learning on teachers' assessment practices, while participating, using and reflecting as members of a virtual learning community?

2. RESEARCH METHODOLOGY

Although some authors like Moreira (2009), Sanmartí (2007) and Silva (2009) defend an excellence assessment in every subject, including science, there are very few studies being developed in Portugal that embrace assessment in science and teacher training, and even less studies that develop a range of assessment tools that, indeed, help teachers improve their own practices in evaluating students in different moments of the teaching-learning process (Ferreira, 2007). Therefore, and answering some needs and teachers questions we believe that our research can bring new scenarios to learning assessment in Portugal.

This study will take place along three years (February 2012 to January 2015) and the teachers involved are teachers that already have curriculum and didactic knowledge about different strategies of science teaching (CTS projects, experimental work, inquiry...). We selected this target public because those teachers have already questioned and reflected about this issue (Bogdan e Biklen, 1994). For this, we chose to select teachers from primary school (in Portugal, these are teachers from first to sixth grade).

Attending to our target public, and since it is our main goal to improve teachers' assessment practices, our study will predominantly be qualitative and we will follow an action-research approach. In order to answer our research questions, we will use techniques such as inquiry; analysis and observation, as shows table 1:

Table 1. Research questions, technical data analysis and instruments for data collection

Researh Question	Technical Data Analysis	Instruments for data collection/ Data sources
i) conceptions and practice of science teachers		
Is there a relationship between teachers' conceptions and their classroom practices?	Inquiry Analysis	Survey; Legal documents related to the assessment of student learning.
ii) Training strategies:		
What is the impact, on teachers assessment practices' in:		
What is the impact of attending a training program about assessment of student learning on teachers' assessment practices, while participating, using and reflecting as members of a virtual learning community?	Inquiry Analysis Observation	Interview; Reflective portfolio; Researcher's journal.

Our investigation will involve four different phases that will be complemented and will developed cyclically:

Phase I - Establishment of theoretical support of the problem through a comprehensive documentary survey of the state of the art; of the process and the tools for assessment of student learning; training programmes for teachers of elementary school in the area, and the potential of new training scenarios through the development of virtual learning communities.

Phase II - Design, produce and validate resources to implement the teacher-training program on assessment of students' learning. This phase is subdivided into three basic steps:
Step 1 - data collection about teachers' conceptions (survey) on the assessment of student learning and scientific updating needs and pedagogic development in the area;
Step 2 - conception, production and validation of a teacher-training program of primary school in the context of assessment of student learning, taking into account the evidence gathered by the application of the survey;

Step 3 - Development (design, produce and validate) of the learning virtual network with the tools required for assessing student learning (thinking skills/scientific concepts and scientific processes and attitudes) in science education.

Phase III - Implementation of the teacher-training program, in order to provide support in manipulation and exploration of the virtual learning network, and the assessment tools made available in the platform. This step will be developed according to the following approaches:
a) Develop a conceptual framework about students' assessment in primary school (principles, typologies, techniques and instruments);
b) Plan, analyze and reflect about assessment tools that can be used in the context of the classroom, and focused on Science targets;
c) Analyze and stimulate the use of the virtual learning network in the context of training;
d) Implement, in the classroom, the assessment tools developed in the training program through the exploration of the platform.
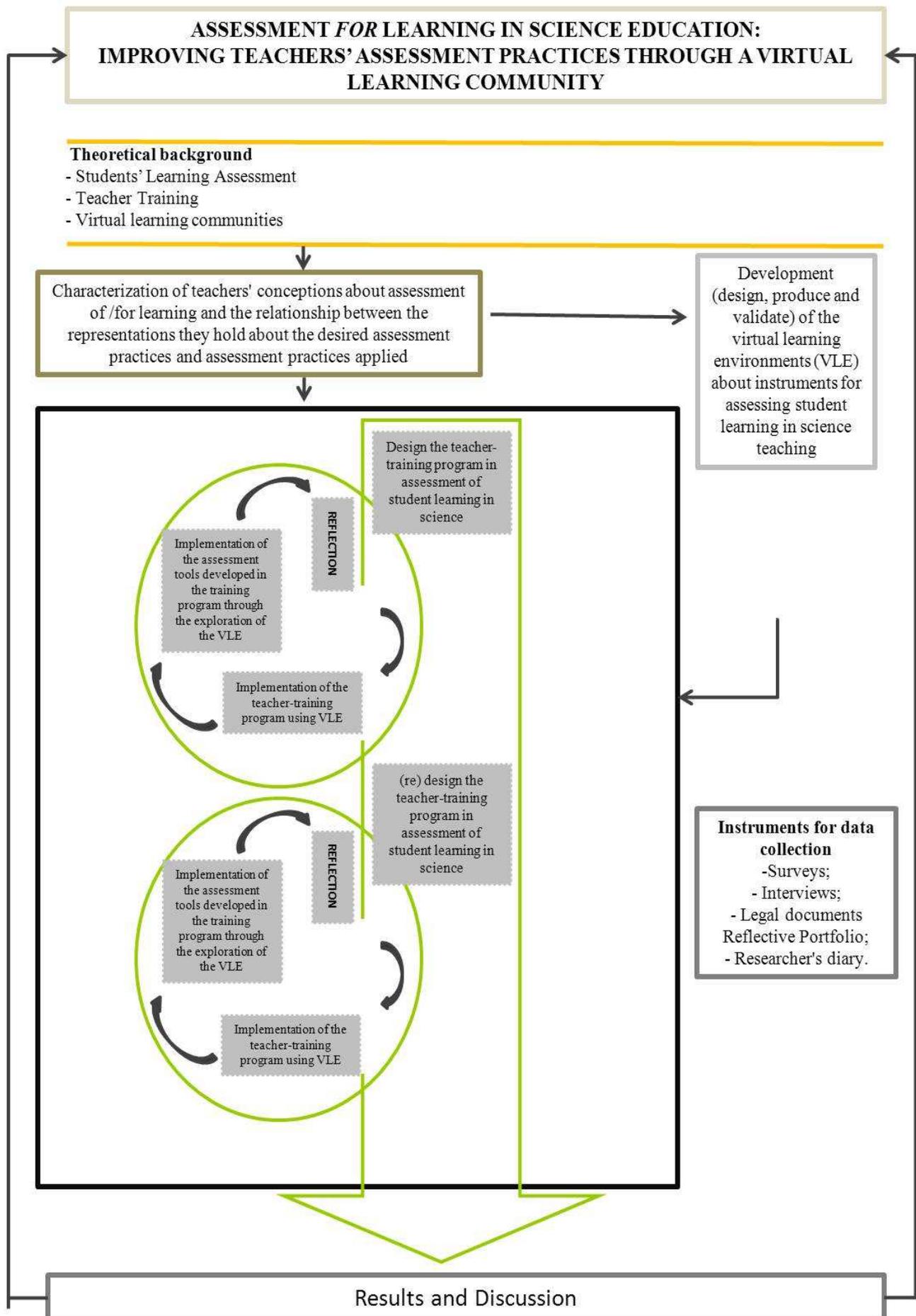
To conclude this phase and move to the last one, which will take several group sessions (face-to-face and online). Throughout these sessions, and in order to assess the teacher training program and the virtual learning environment on the impact of these in their practices, teachers will be asked to draw a critical and reflexive portfolio, and interviewed. At the same time, the collected data will be triangulated with the data collected in the researcher's diary.

If the data collected allows us to conclude those teachers' assessment practices improved, we take our study as to have been concluded. Otherwise, if the data collected does not allow us to conclude those teachers' assessment practices did not improve, the necessary adjustments will be made and a new research cycle will be started until the desired changes take place.

Phase IV - Assess the empirical data in order to find the relevance of the teacher-training program and the virtual learning environment. At this point we will able to answer the research questions defined.

In order to clarify what was previously described, we constructed a framework/scheme that articulates the different research questions with the techniques and instruments for data collection, and a plan that contextualizes the whole process.

Image 1. Layout of the investigation

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Theoretical background
- Students' Learning Assessment
- Teacher Training
- Virtual learning communities

Characterization of teachers' conceptions about assessment of /for learning and the relationship between the representations they hold about the desired assessment practices and assessment practices applied

Development (design, produce and validate) of the virtual learning environments (VLE) about instruments for assessing student learning in science teaching

Design the teacher-training program in assessment of student learning in science

REFLECTION

Implementation of the assessment tools developed in the training program through the exploration of the VLE

Implementation of the teacher-training program using VLE

(re) design the teacher-training program in assessment of student learning in science

REFLECTION

Implementation of the assessment tools developed in the training program through the exploration of the VLE

Implementation of the teacher-training program using VLE

Instruments for data collection
-Surveys;
- Interviews;
- Legal documents
Reflective Portfolio;
- Researcher's diary.

Results and Discussion

3. DISCUSSION AND RESEARCH PERSPECTIVES

For the discussion and reflection of our investigation we will try to put forward possible limitations, but also its relevance and possible impact on teacher training, improving teachers' practices regarding the assessment of student learning in science and discussing its transformative potential. To analyze the transforming potential of our research project we will review some aspects that will allow us to locate and position our research project as a producer or transformer of the research context in education, such as the analysis of the *Scope & Purpose of Research,* the *Conceptual Framework* and the *Methodological Framework*.

Regarding the *Scope & Purpose of Investigation*, specifically as to the subject matter and the issues under review, we can assume that the design of research can enhance a transformative potential, as part of a continuum of experiences and reflections that we have assumed based on our experience as professionals and as researchers. This research project is an attempt to approach the debate that exists between theory and practice, as well as between the constraints of teachers and the research that is done in education (Vieira, Silva Melo, Moreira, Oliveira, Gomes, Albuquerque & Sousa, 2004).

Following the questions, concerns, and evidence that emerged, the Ministry of Education (2010) conceived the Learning Goals Project that offers the teacher a common framework of the results to achieve by students, and suggestions of work and assessment strategies that can guide and support teaching for the success of learning (ME-DGIDC, 2010). Although the presentation of this project aims to discuss and share suggestions for evaluation strategies we consider it vital, more than sharing, the implementation of a teacher-training program, where teachers can discuss, reflect, share and develop techniques and assessment tools that may help them improve their assessment practices.

In order to meet the goals set above, we consider it essential to create a teacher-training program through a dynamic and collaborative virtual learning community. According to Vieira (2009b), this research project is fundamental to transform teaching, learning and teacher professional development. With this teacher training program we will do our best to ensure that both the teacher trainer (TT) as the teacher in training (TiT) take on a posture of teacher-researcher in an attempt to seek to transform the assessment skills through a collaborative discussion of their own practices. In this context it is important to develop training schemes for a more powerful research, where trainees and trainers take different roles (Vieira & Moreira, 2011; Vieira, 2009a, 2009b). Given that within a professional culture in which there is a fear of openness to the other through interdisciplinary dialogue and collaboration, there is a tendency to think that teaching, research and teacher professional development activities are relatively isolated from each other, it being fundamental to create cultures of collaboration for the management and renewal of teaching, learning and teacher training, focusing on the operation of their practices (Vieira, 2009*b*, p. 117).

It is in Vieira (2004) that our project found its theoretical foundation, assuming that teacher training programmes undertaken through the establishment and expansion of virtual learning communities, promote the transformative potential of research. Thus, and according to this author, teacher training is scarce and tends to translate into actions of short duration that often become generalist without any experiential dimension. This limits its meaning and impact. Therefore, and taking the use of online communities as a strategy, we should create formative scenarios where the (re) construction of professional knowledge and professional action are

inseparable from experience and reflection about and on the experience itself (Schön, 1983, 1987; *apud* Vieira, 2009b).

Although considering a real and concrete training strategy, we will be attentive to what Vieira defines as an extremely complex approach, because: it requires conceptual and methodological tools of scrutiny of thought and action that we possibly do not possess; a high level of self-questioning and confrontation with the other; an ability to accept uncertainty and face obstacles; a high understanding of the complexity and the dilemmas of educational action that can paralyze decision-making; a sense of professional autonomy that often comes into conflict with the requirements of our contexts (Vieira *et al* 2004, p. 6).

Assuming the teacher training program will have a more humanistic and emancipatory perspective, that accepts plurality, respecting prior experience, interests and expectations of each teacher (each teacher must find their way, but in dialogue with the other), we assume an investment in promoting the transformed potential not only on the practices of TiT, but also in the practice of TT. It is essential to value the other in building knowledge, and for changes to occur, the promotion of moments that harmoniously coexist in individual spaces of thought and action – and even in the tension between the individual and the collective –, transformative energy and the dynamics of the group will have to reside (Vieira *et al* 2004).

The ***Conceptual Framework*** of this research does not have, as yet, a well-defined theoretical framework. We can only assume that we believe and define a concept of education that empowers the individual success of each student to develop skills that allow him/her to act and live in society, in a sustained, informed and reasoned way. Taking education as an entity that is based on principles and didactic and pedagogical strategies through the promotion of questioning, we believe in an assessment FOR student learning in science, that empowers individual success.

From the point of view of the ***Methodological Framework***, and taking as its starting point the objectives and research questions defined, our doctoral project is based on a qualitative research approach, adopting an action research (AR) design. This option relates to the fact that we want to aggregate teaching, research and professional development practices through inquiry. This research methodology can lead to a transformative potential of research since we assume it as a means to a deeper understanding and informed intervention in order to improve the rationality, justice and democratic nature of situations and work contexts through a spiral methodology of planning, action, observation and reflection on action (Vieira *et al*, 2011), placing it at the service of a transforming research.

Concluding, we consider that we are unveiling paths that will enable us to conduct and discuss a research project that is achievable and workable on the ground and meets the real needs, interests and constraints of teachers. Although we haven't yet gathered evidence to address questions about future results and implications of the study we can, however, share our goals and ambitions. With the work we propose to do we hope to have an impact on teachers in training that will share and reflect with us, and also an impact in the respective intervention contexts.

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