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We need challenges!: The case on Four Project-Based Learning initiatives at Portuguese Higher Education Institutions

Abstract

Project-Based Learning (PBL) is a methodology with roots in the work of educational philosopher John Dewey (1959) and it is now, more than ever, essential in educational practices. Higher Education (HE) needs to refine andragogic practices and challenges related to the new generation of students (Millennials), who value learning by doing, technology and a global and eclectic approach, and PBL is as an optimal solution. Although this is widely spread among HE teachers, they still have limitations when implementing PBL and further training is needed in order to implement successful practices (Bilgin, Karakuyu, & Ay, 2015). The aim of this Multiple Case Study is to present and analyze four PBL practices in HE in Portugal: 'Ipam Leadership Challenge', 'One Pitch, one Cause', 'Arcadia Challenge' and 'ESB Delivering science into the community'. The outline of the Buck Institute for Education (BIE) will be used as a framework of analysis, which defines PBL as a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge. This approach uses the 8 Essential Elements of PBL (Mergendoller & Larmer, 2015): (i) Key Knowledge, Understanding, and Success Skills; (ii) Challenging Problem or Question; (iii) Sustained Inquiry; (iv) Authenticity; (v) Student Voice & Choice; (vi) Reflection; (vii) Critique & Revision and (viii) Public Product. We finish with a brief discussion and reflections on the future of PBL at HE institutions.

Key-words: Project-Based Learning, Higher Education Institutions, Portugal, Case study

I. A Brief Introduction to Project Based-Learning (PBL)

Confucius and Aristotle were early proponents of learning by doing (Boss, 2011). And its long known and proved by educational psychologists and other human behaviour researchers that new knowledge and learning are better consolidated if built on previous existent knowledge and experience, especially in andragogic settings, which is the case of higher education.

Although this idea is widely spread and common among teachers, they still feel some limitations when implementing PBL approaches and recognize that further training is needed in order to implement successful PBL practices (Bilgin et al., 2015).

The term 'project learning' dates back to William Kilpatrick, who first used the term in 1918 (Larmer, 2015). The roots of project-based learning extend back over a hundred years, to the work of educator and philosopher John Dewey (1959) whose Laboratory School at the University of Chicago was based on the process of inquiry. Dewey argued that students will develop personal investment in the material if they engage in real, meaningful tasks and problems that emulate what experts do in real-world situations (Krajcik & Blumenfeld, 2006, p. 318)

The big boom happens at the end of the '90 of XX century, when educators realized that school was boring for students, that engagement was low and the learning skills remained at a superficial level (Krajcik & Blumenfeld, 2006)

As a mere exemplificative reflection, Table 1 exhibits a Google scholar Search results (May 2018). We used the key words 'project-based learning'. The results suggest an increasing interest on the topic.

Table 1. Google Scholar search Results, using key-word 'Project-Based Learning'

Years	Number of Hits 'project-based learning'
All years	92400
2010-2018	25100
2000-2010	18200
1990-2000	2540
1980-1990	130

Project-based learning is a form of "situated learning and it is based on the constructivist finding that students gain a deeper understanding of material when they actively construct their understand by working with and using ideas" (Krajcik & Blumenfeld, 2006, p. 318).

Thomas and Mergendoller's (2000) qualitative study of K-12 teachers implementing PBL suggested that one challenge to PBL implementation involves how to find and incorporate community partners. Their study revealed teachers' need to take sufficient time to work through the feasibility and the desired nature of the partnership before PBL lessons begin. Furthermore, their study documented teachers' difficulty with bringing outside experts into class to coincide with when students need information. Thomas' review of PBL research for the Buck Institute (2000) described earlier work by Sage (1996) that found teachers confronting difficulty in developing problem scenarios for authentic work.

Thomas (2000) framed the challenge of working with community partners by calling for future research on PBL:

"Very little is known about the challenges by teachers in developing and enacting PBL on their own. Existing research on implementation is useful for identifying the kinds of training and support teachers need when using packaged or published materials...but these findings may not generalize to or fully capture the challenges of teacher-initiated PBL (p. 38).

Regarding PBL in Higher Education, Frank and Barzilai (2004, cited by Lee, Blackwell, Drake, & Moran, 2014) implemented PBL in a course for science and technology preservice teachers that aimed to prepare these future teachers to teach using PBL by doing PBL. They find several benefits to student learning, including substantial interdisciplinary knowledge acquisition and an increase in motivation and responsibility, and note the importance of incorporating formative assessments throughout the PBL process.

Papastergiou (2005) (2005, cited by Lee et al., 2014) also found that PBL increased preservice teachers' engagement and motivation in a course on educational website design.

Wilhelm, Sherrod, and Walters (2008, cited by Lee et al., 2014) found that the mathematics understanding of preservice teachers improved significantly after they had completed a science focused project requiring them to understand and apply particular mathematical concepts.

Today, many sub products exist around PBL, for example: Casebased learning, Challengebased learning, Gamebased learning, Passionbased learning, Problembased learning, Servicebased learning, Team-based learning, Workbased learning and even Zombie-based learning and many more sub variants of PBL(Larmer, 2015).

So, the aim of this article is to present four different experiences of PBL in two different Higher Education Institutions in Portugal, framing these experiences into a Framework of analysis.

II. A framework of analysis: The 8 PBL Essential Elements from Buck Institute for Education

The framework we will use Buck Institute for Education (BIE)¹ and authors of the “8 Essential Elements of PBL”(Mergendoller & Larmer, 2015)

Project Based Learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge. Projects are focused on student learning goals and BIE defines 8 Essential Project Design Elements (Table 2).

Table 2. *The 8 Essential Elements of PBL (Mergendoller & Larmer, 2015)*

Principle	Description
Key Knowledge, Understanding, and Success Skills	The project is focused on student learning goals, including standards-based content and skills such as critical thinking/problem solving, communication, collaboration, and self-management.
Challenging Problem/Question	The project is framed by a meaningful problem to solve or a question to answer, at the appropriate level of challenge.
Sustained Inquiry	Students engage in a rigorous, extended process of asking questions, finding resources, and applying information.
Authenticity	The project features real-world context, tasks and tools, quality standards, or impact – or speaks to students’ personal concerns, interests, and issues in their lives.
Student Voice & Choice	Students make some decisions about the project, including how they work and what they create.
Reflection	Students and teachers reflect on learning, the effectiveness of their inquiry and project activities, the quality of student work, obstacles and how to overcome them.
Critique & Revision	Students give, receive, and use feedback to improve their process and products.
Public Product	Students make their project work public by explaining, displaying and/or presenting it to people beyond the classroom.

III. Methods

A Case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context (Yin, 2003). In this paper we present a non-experimental, descriptive multiple case study of four different Project-based learning projects, that took place in Portugal.

A multiple case study approach was adopted where each case is a project implemented by three different teachers. Teachers were selected in order to get a broader view on how teachers define and use PBL and to allow for finding particularities and common features between them.

3.1. Sample

Four projects, by 3 different teachers, from 2 different HE Institutions were used in this convenient sample.

3.2. Procedure

After implementing the projects, the three teachers gathered and analyzed each project critically, and were asked to describe in detail each project, as well as articulated them with Buck Institute Framework for PBL.

¹ BIE is the founder of <http://www.PBL-online.org>.

3.3. Instruments

A grid analyses based on BUCK Institute Framework on PBL.

3.4. Data Collection and Analysis

Document Collection Planning materials and teachers self-reflections were collected. To achieve rigor and trustworthiness in this multiple case study, some strategies were used: investigator triangulation, Member Checks, Prolonged Engagement, Articulating data collection decisions and Bracketing (Araújo, 2015).

IV. Findings

4.1. The Ipam Leadership Challenge

"Ipam Leadership Challenge" was a PBL implemented in IPAM Porto and Ipam Lisbon, in 2016, 2017 and 2018. We can frame Ipam Leadership Challenge as PBL in general, and a Team-based learning, Challenge-based Learning and Passion-based learning, in particular. Focusing on leadership skills all round, the main core of this PBL is to engage students team into organizing from scratch, a scientific-oriented event on leadership, involving Portuguese leaders and bringing the general public to this learning opportunity.



Figure 1. Ipam Leadership Challenge Logo, totally developed by IPAM students

Table 3. *Ipam Leadership Challenge analysis using Buck Institute for Education Framework*

Key Knowledge, Understanding, and Success Skills	Leadership skills are central in a graduate's life. In order to promote self-leadership and shared leadership, student's teams (formed in the first class by their choice) develop a project which consists of organizing a full event with key note speakers on leadership. Furthermore, they choose which Portuguese Leaders they want to invite, and articulate every detail of the projet with the speaker and the teacher.
Challenging Problem/Question	Student's teams have challenge: inviting and organizing the event of a keynote speaker. Each group of students decides contacts, negotiates, organizes and documents in the press (news releases, pictures and blog postings) the whole experience. The main goal is to contribute to leadership learning, for them and for the whole community (open event to general public)
Sustained Inquiry	Student's teams search actively the careers and leadership experience experience of the potential keynote speaker to be invited. They receive a full checklist with explorations, reflections and orientations on how to organize the event.
Authenticity	Leadership is one of the main transversal skills for employability nowadays, so the idea to absorb experience from real leaders in Portuguese market fundaments authenticity.
Student Voice & Choice	Student's teams make almost all the decisions in this challenge-based project.
Reflection	At the end of the curricular unit and the event per se, Student's teams and teacher reflect upon the initiative. Also, students write a reflexive report.
Critique & Revision	During all classes students received personalized guidance by teacher and feedback for improvement
Public Product	Blog, entirely developed by students, including news production on each session and photographic records (http://ipamleadershipchallenge.blogspot.pt/) Final event open to general public. An Article was also published in a Human resources magazine (Araújo, 2018)

4.2. The “One Pitch For One Cause” Challenge

“One Pitch for One Cause”² was a PBL implemented in Ipam Lisbon, in 2017, with a particular characteristic of a Servicebased learning, which can be described as a PBL that combines learning goals and community service in ways that can enhance both student growth and the common good (Bandy, n.d.).

Furthermore, it is a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities (National Service Learning Clearinghouse cited by Bandy, n.d.).

In general, this PBL aimed to put to good use the academic assignment by the students (A scientific organizational study on non-profit organizations) offering that report to them and promoting connections between non-profit organizations and the corporate world (promoting social responsibility initiatives).



Figure 2. Ipam Leadership Challenge, developed by teacher and students

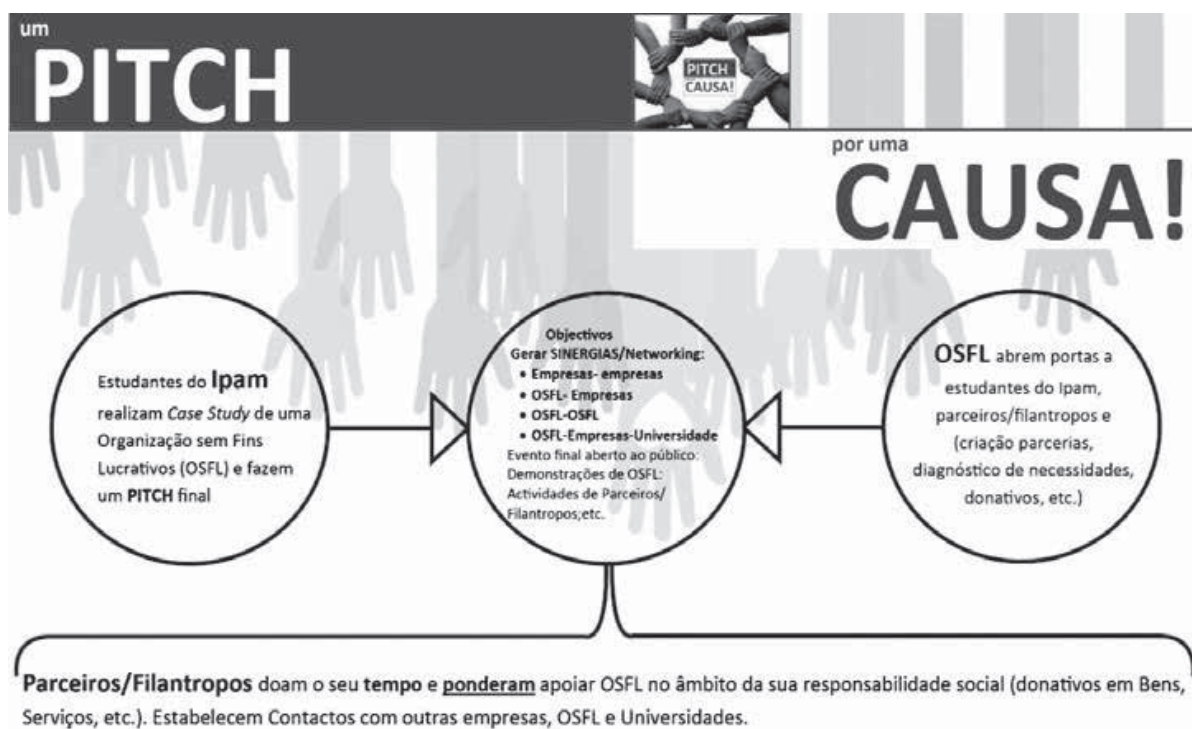


Figure 3. Scheme describing the project’s flow and intervenients.

² The Project’s original name in Portuguese was: “Um Pitch por uma causa”

Table 4. *“One Pitch, One Cause” analysis using Buck Institute for Education Framework*

Key Knowledge, Understanding, and Success Skills	Organizational behaviour curricular unit implies that students deepen their knowledge on organizations and research methods to characterize them. Furthermore, for several specialists, partnerships between organizations and between universities and the corporate world, are considered the path for success.
Challenging Problem/ Question	Student’s teams have challenge: finding an Non-profit organizations for which to do a full characterization using organizational methods. On the other hand, students and teacher find corporate, profit-oriented organizations available to hear and support non-profit-organizations in some way, increasing their social responsibility to the community (Service-based learning).
Sustained Inquiry	Student’s teams were oriented by the teacher in specific moments in class. Students bring several challenges to the teacher regarding the functioning of organizations and several organizational behaviour challenges (Organigram, mission and values, history, human resources practices, gender equality, well-being at work programs, etc.). They receive a full checklist with explorations, reflections and orientations on how to organize the approach organizations.
Authenticity	Working in real organizations, profit and non-profit, and promotion partnerships between them is an authentic hands on project.
Student Voice & Choice	Student’s teams make almost all the decisions in this service-based project, with the teacher scientific guidance in order to not loose track of organizational behaviour approaches and ethics.
Reflection	At the end of the curricular unit and the event per se, Student’s teams and teacher reflect upon the initiative. Also, students write a full report with reflexive component. Their work, after revision, is offered to the organizations involved. (Some students took it further and even made a video promoting the non-profit organization and a collection of money and clothes)
Critique & Revision	During all classes students received personalized guidance by teacher and feedback for improvement
Public Product	Final event, with each Team Pitch about the non-profit Organization was open to general public. (Non-profit organizations received the academic reports on them and corporate organizations gained social responsibility visibility)

4.3. The Arcádia Challenge

“Arcádia Challenge” was a PBL implemented in IPAM Porto during the 2016 and 2017 within the scope of ‘Product Management’ and ‘Price Management’ formal curricular units (belonging to the bachelor degree in Marketing Management).

We can frame “Arcádia Challenge” as PBL in general, and a Challenge-Based Learning and Team-Based Learning in particular. The main aim of this Challenge consisted in involving students’ teams in the resolution of four real product and price management challenges.

Since 1933 ARCÁDIA has been the premier Portuguese artisan chocolates maker. Using original recipes with more than 80 years and exclusively natural products previously selected, ARCÁDIA have currently as main products, artisan chocolates, handmade candies, almonds and selected pastry.

The Brand’s main mission is to combine the unparalleled quality of the Portuguese tradition with the impositions of contemporary time since the brand stands on the market in a concept of luxury and sophistication.

Table 5. Arcadia-Challenge analysis using Buck Institute for Education Framework

Key Knowledge, Understanding, and Success Skills	Arcadia Challenge Project started with an initial invitation to Arcadia company by the Facilitator (Teacher of the above-mentioned Curricular Units). In order to articulate company needs with the main aims and competences of the Curricular Units, Facilitator present this aims previously to the Company. At the beginning of the school year, "Arcadia Challenge" was presented to students team by Facilitator and by Arcádia CEO. In this initial Briefing to the students, the objectives of the challenge were precisely defined. The challenge consist in find answers to four concrete problems of the company. Small work groups were created under the guidance of the facilitator so that the students were able to reach the proposed objectives.
Challenging Problem/Question	These are the four problems presented by the company to the students: (i) <i>Private Label Stores versus Large Surfaces</i> It's possible to have same product for different realities? Suggest strategies to boost sales on both channels with the least possible conflict. (ii) <i>Licensing agreement with the three major Portuguese Football Clubs</i> Sale in Arcadia Stores or Club Stores? Strategies to exponentially increase short-term sales. (iii) <i>How to innovate and broaden the range of Chocolate Candy?</i> Suggestions to create dynamism and rejuvenate the Brand (iv) <i>Extension of the range of pastries (biscuits and jams)</i> It's possible promote interaction between the various product ranges by creating baskets?
Sustained Inquiry	In the initial session of Project presentation, students had the opportunity after the briefing to clarify with the CEO all doubts that have arisen in the meantime to carry out the work. Each group chose the problem they wanted to work on and during the semester both the Facilitator and the Company were always available to answer all the questions that were posed by the different working groups.
Authenticity	This project was originally based on a real context in which the problems presented were in fact problems for which the company had to find a response in the short / medium term.
Student Voice & Choice	After solving the problems students presented their suggestions to the proposed problem. The best suggestions were effectively implemented by the company.
Reflection	Throughout the process there were weekly tutorial sessions with the Facilitator where students present their work developed results, as well as eventual obstacles to their development. These moments of reflection allowed students to have timely feedback of the activities developed and to make possible corrections / adjustments to their work.
Critique & Revision	Students were always encouraged by the Facilitator to develop good interpersonal communication and to promote autonomy in learning. The ability to assess your own performance and the performance of the rest of the group was also fostered. During all classes students received personalized guidance by teacher and feedback for improvement.
Public Product	All the Projects had a public presentation counting with the presence of Facilitator, the Company CEO and the Company Marketing Director. There was also public disclosure of the Project in the University Weekly Newsletter, both in the start-up phase and in the final public presentation of the results. Some of the ideas presented by students were applied in practice such as packaging changes, new chocolate flavours and extension of the range of pastries.

4.4. The "Delivering Science into the Community' Project

"Delivering science into the community" Project is a 21h program on "Personal Skills Development" in the undergraduate degree of Microbiology and Bioengineering. It has been taught since 2011, and involves 11 Portuguese High schools³. Personal skills development take place on a par with a project that follows the guidelines of Project Based Learning. While students need to choose a real world question out of possible 36, they are also exposed to the development of several personal skills deemed crucial in today's labor markets (e.g. team work, planning and communication).

The project is carried out in 6 sessions throughout the semester and involves one facilitator. Students are encouraged to organize and plan their activities autonomously as a team. They create their own identity,

³ Colégio D. Dinis .Sta. Catarina; Colégio D. Duarte, Colégio de Ermesinde; Colégio Internato dos Carvalhos; Colégio de Santa Maria de Lamas; Colégio Luso Francês; Escola Secundária João Gonçalves Zarco; Colégio Ellen Key; Escola secundária com 2º/3º ciclos Clara de Resende; Escola Secundária D.Sancho I- Vila Nova de Famalicão and Colégio Nossa Senhora de Lourdes.

name, logo, mission, objectives values and rules. Figure 4 illustrates a sample of logos designed by students. They are also encourage to use all the facilities available in the School, namely, libraries, data bases, as well as professors and lab assistants. They were also persuaded to provide and listen to colleagues' feedback. Devise what knowledge needs to be divulged, students have to decide about the way to present their findings, and organize the workshop that follows the final, and public presentation.

A simulation takes place before the final presentations, so that project teams are able to listen to constructive critiques and suggestions from academic staff. The final presentation takes place in a school chose by the teams, and it serves the purpose for disseminating knowledge among primary and secondary education students.

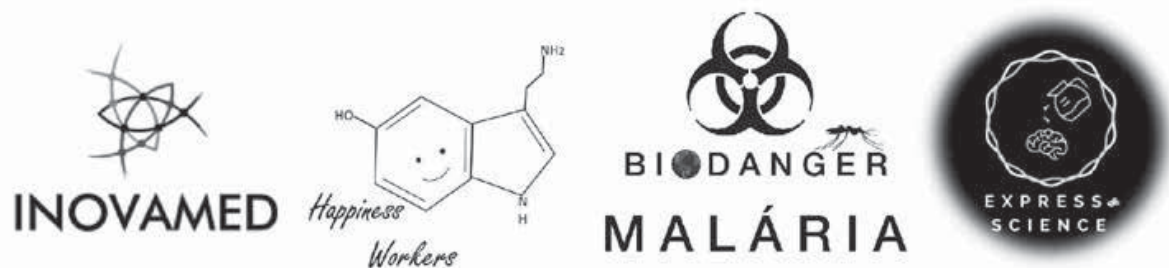


Figure 4. A Sample of Team Logos created by student's teams for their projects

"Delivering science into the community" Project embeds the 8 Essential Project Design Elements of PBL as described in table 6.

Table 6. "Delivering Science into the Community"
Project analysis using Buck Institute for Education Framework

Key Knowledge, Understanding, and Success Skills	Delivering Science into the community is central to futures science researchers and professionals in the biotechnology fields. At Escola Superior de Biotecnologia of the Catholic University of Portugal., the goal of PBL is twofold: (1) to acquire knowledge and share it with the community (lay people) and (2) to develop transferable skills (e.g. teamwork, communication, planning and time management).
Challenging Problem/Question	Students may choose their project from an array of 36 meaningful topics. They need to identify a specific question, find answers and chose how to communicate it to a larger audience. ¹
Sustained Inquiry	Students engage in research, using available methods and resources (e.g. research methods; experts; library databases and business companies). They are also required to participate in 6 training skills sessions with the facilitator.
Authenticity	The topics student's research pertain to real life context. Project have a real impact on others in their community (e.g. to raise awareness of primary and secondary education students regarding vocational choices.)
Student Voice & Choice	Students have control of the process, they decide what to research, how to research, whom to present and how to present the knowledge.
Reflection	Students are encouraged to reflect upon the whole learning experience at different stages of the process. They are also encouraged to reflect on the working process as a team. They also has to reflect on the different ways to present the knowledge they have acquired to their audience and finally a broader reflection is included in the project report.
Critique & Revision	Students has to critically assess the sources of information used; they have to follow methodological protocol and simulated presentation in order to receive constructive feedback which allows them to revise the final presentation.
Public Product	Students deliver a presentation followed by a Workshop which includes different activities according to each project (e.g. game contest "Who Wants to Be a Millionaire"; "Planning a tasting session of insect recipes for a more sustainable world").

⁴ Some of the topics available for students to choose from were: (1) Water Footprint - "hidden" water that we use on a daily basis; (2) New gourmet foods: insects; (3) Food: to deal with the crisis without neglecting the quality; (4) Quick diets: what you get and what you lose; (5) Be a responsible consumer: Can clothes, toys, mattresses be damaging to your health and that of your children?; (6) Chemicals in day-to-day products linked to neurological disorders in children; (7) Antibiotic resistance: a clinical and public health problem; (8) Emerging pollutants: a problem for all of us; (9) Bioengineering: solutions for a healthier and sustainable environment (10) Hydroxyapatite for biomedical applications, among others.

V. Conclusions and Final considerations

Overall, the four projects presented in this analysis were Project-based Learning initiatives implemented with success and, after the articulation with the BIE framework, the three teachers and researchers were able to further reflect in integrate their own didactic experience. Nevertheless, being a good HE teacher is also to be able to self-criticize and to look for future improvements.

The main self-critique is that, as PBL facilitators we should have used a PBL framework from the start to help navigate teacher and students throughout the project. This future-oriented and framed guidelines would have helped students, teachers and the university itself to understand, incorporate and adopt PBL more easily.

Implementing a project-based learning in a formal curricular unit in higher education is, in Portugal, a big challenge. Portuguese Higher Education Institutions have budget limitations and teachers careers are in several ways, very far behind other European institutions with “on-call” and paid by the hour teacher becoming increasingly common. So, frequently, teacher who engaged in PBL are often passionate by the subject and do it in their own hours. For example, Bradley-Levine, Berghoff, Seybold, Sever, Blackwell, & Smiley (2010) study recognized that PBL required more of them and their colleagues:

PBL teaching takes *more* time to plan, *more* curriculum and technology resources, *more* day-to-day problem solving about how to scaffold student growth and success in their project work, *more* effort to authentically assess student learning, *more* communication with persons in the community, *more* support from the administration in terms of suitable scheduling and curriculum alignment, and *more* opportunities to collaborate with their teaching colleagues (Bradley-Levine et al., 2010, pp. 19-20).

Students are not used to work with PBL and in the beginning, they show a degree of resistance. However, as they get involved in the project their attitude change. By the end of the project students talked about it enthusiastically (1) “it was an important challenge for us, we could learn more about a scientific theme but also we improve communication skills and we felt more responsible presenting our work outside university.”, (2) I was very anxious at the beginning. I thought I would never present for a bunch of unfamiliar faces. I was used to deliver presentations to my fellow colleagues and professors; this was an incredible experience”, (3) “It is quite interesting to talk about our experience at the university, to give advice to the youngest”, (4) “I felt a strong support from the group. I never worked with them before, nevertheless they helped me to overcome my difficulties. Today I felt that I was more confident, I know more about the topic that I would not know if I hadn’t enrolled in this course”.

In general, the experience to go outside the walls provides a sense of positive anxiety that help students to overcome their difficulties. Therefore PBL creates the opportunities to increase the level of students self-efficacy (Dunlap, 2005).

On the other hand, one of the biggest difficulty in implementing a PBL Project in HE is, in the initial phase, the selection of the organizations that will collaborate with us and get them to perceive the participation advantages in this kind of projects.

A good teacher is a forever student. To improve as educators, we must be in constant learning and be open to point out the limitations in our teaching practices. Limitations of this paper includes: (i) convenient sample of projects and teachers and (ii) in this work, we did not collect in a structured form, the feedback for students, and so, we could not analyzed it using, for example, content analyses.

At last, it is important to reflect upon PBL training for HE teachers. Many HE teachers do not have pedagogic (or andragogic) training, which in many countries is mandatory to become a university or college teacher. In Portugal in particular, if you have a PhD (and in some cases, a masters degree) you are automatically able to become a teacher/Professor. Furthermore, many HE teachers are using PBL methodology and don’t even know the methodology name or principles. In a world where Higher Education is advised to become more digital, more focused and student-centered, this may be the most important training a HE teacher should have.

Beyond training, PBL teachers should develop a specific profile. For example, the ‘M.O.D.E.L. Profile’ developed by Araújo and Fernandes (2017) argued that transferable skills curricular units teachers should have a degree in social sciences, a sense of leadership, a conscious approach using Bandura’s Social Learning and Modelling theory, a robust core of andragogy skills and, maybe the most important, a focus and unconditional vocation towards human development.

We hope that sharing with the scientific community our own PBL experiences might contribute to improving everyone’s practice and that, in the future, the meaning Higher Education would walk and in hand with PBL projects.

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