

Pathway to support the adoption of PBL in open data education

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Abstract

Governments, public sector institutions and organisations have started releasing and sharing information in the format of open data (OD). The opportunities to create and innovate with OD will continue to grow, and there is an expectation that educational institutions will produce competitive graduates with OD skills. A key question arising from these expectations is how to equip the workforce and students with OD skills. Based on literature from education design and design fields and an empirical analysis of different OD training activities in five European countries, we identified a need to support OD teachers by developing a visual, structured and simple model to guide them through the adaption and implementation of PBL and foster their competences as learning designers, thus the paper proposes an OD–Problem-Based Learning (PBL) pathway model. The pathway model aims to guide educators by structuring the design process of OD training activities and promotes design skills among teachers. The pathway model comprises five main steps: understand, review, design, teach and reflect. Each step provides guidelines on how to plan an OD course.

Key words

learning design, problem based learning, teacher as designer, open data, university training, and vocational education

Introduction

In the past years, governments, public sector institutions and organisations have started releasing and sharing information in the format of open data (OD) to contribute to economic growth and increase transparency. Building on the principles of openness, participation and collaboration, the OD movement works towards increasing access to data and analytic tools that can reduce the need for specialist analysis competences in working with OD (Kitchin, 2014). Furthermore, the movement aims to (1) increase citizen participation in public management to foster transparency and accountability and (2) create new services and products by combining public data with other datasets to foster innovation and creativity (Carreras, Fischer, & van Steenberg, 2015; European Commission, 2011; Kuk & Davies, 2011). However, fulfilling the potential of OD has faced difficulties

getting the public to use the data because most people are unable to collect, process, merge and make sense of it (Hellberg & Hedström, 2015). Other challenges relate to the quality and format of the data and to organisational challenges such as changing the cultural mind-set and establishing collaboration among multiple actors to exploit OD (Carreras et al., 2015).

The opportunity to create and innovate with OD will continue to grow and there is an expectation that educational institutions will produce competitive graduates with OD skills. It is also expected that employees and civil servants will develop those skills. However, it is not yet clear how to equip the workforce and students with OD skills. The present paper is framed within a project that aims to develop and promote OD education and training. The project is called ODEdu: Innovative Open Data Education and Training based on PBL and Learning Analytics (<http://odedu-project.eu/>). The project aims to establish a Knowledge Alliance between academia, business and the public sector to promote OD education and training. One of the goals of the project is to develop a learning model based on PBL and learning analytics. The assumption of the project is that PBL may be a pedagogical approach that will foster innovation and novel training activities within the OD field. The consortium consists of partners in five European countries (Greece, Malta, the UK, Belgium and Denmark) and local partners from three different sectors: academia, industry and the government.

The European Data Portal report (Carreras et al., 2015) has identified that people working with data should have the necessary skills to not only to understand the data but also communicate the results to the relevant stakeholders, and they therefore need both hard and soft skills. Hard skills refer to domain knowledge, mathematic and statistical knowledge, and technical skills, while soft skills refer to problem solving, storytelling, collaboration, curiosity, communication and creativity (Carreras et al., 2015). The development of those two sets of skills could be linked with a pedagogical discussion about feasible teaching approaches and the teachers' skills to teach OD.

From an initial reading these soft skills seem to align well with what is suggested in the literature, that Problem-Based Learning (PBL) approaches can help students develop. PBL fosters not only development of content knowledge (hard skills) but also soft skills. However, while on the surface it seems that PBL fits well with OD training and education, there is a need to better understand how OD training is currently carried out and what are the pedagogical approaches taken. Therefore, the paper starts from an analysis of the challenges that OD teachers encounter when teaching OD and a review of current international OD teaching activities. Based on the analysis of current OD teaching practice we argue for the relevance of PBL in the context of OD training. However, the literature also shows that the change to PBL is difficult, and therefore drawing on research within educational design and the teacher as designer we develop the OD-PBL pathway model based on design thinking. The aim of the OD-PBL pathway model is to structure the design process of the OD training activities and promote design skills among teachers to adopt PBL in their teaching. The development of the OD-PBL pathway model is the main contribution of the paper.

Open Data teaching practice

This section presents an analysis of how OD training is currently carried out and the challenges that OD teachers encounter. The analysis is based on three different sources. As a first step, a desk study of different OD educational initiatives developed by international institutions was performed to gain insight into the current teaching practice of OD. Next, ODEdu project partners conducted interviews about the challenges and good teaching experiences to map the consortium teaching practice. Third, a workshop provided inputs about effective ways to introduce new OD teachers to the PBL approach.

Desk study of existing OD teaching initiatives

In the desk study, different international initiatives aiming to promote the use of OD were reviewed. A list of six active initiatives were selected to obtain a deeper understanding of their teaching activities: P2PU, Open Nepal, Open Data Day, School of Data, Open Knowledge Foundation and School of Open. The selection was based on references from other actors and we checked the list with one of our ODEdu project partners, Open Data Institute.

Related to the global OD teaching initiatives, we found that the strongest organisation promoting the use of OD is Open Knowledge Foundation, and the three most innovative types of training identified were data expeditions, hackathons and learning circles. The central philosophy of data expeditions is learning by doing, which involves working with real problems, group work and role-play (Radchenko & Sakoyan, 2016). Hackathons, which started in the information technology community, are events where individuals come together to work in an innovative way around a challenge. Zoras (2015) has related hackathons with PBL where an interdisciplinary group of students work on finding a solution to a given problem. Scriven (1984) described the learning circles as a conversation that goes through four phases: exploration (what needs to be learned and why), planning (how the learning is to take place), support (organisation of the selected material) and evaluation (progress of the process and the product).

The review of international OD educational initiatives illustrates that in general, there is little training available for OD and the practice of training OD is a mix between traditional teaching, learning by doing and PBL. The modalities of delivery included face to face, blended learning and online courses. However, none of the organisations have given any concrete pedagogical approaches for their designs.

OD teaching practice within the ODEdu project

An interview study was conducted to understand the teaching practice within the ODEdu consortium. In these interviews, we had the opportunity to focus on the different pedagogical designs of the teaching activities and the successful and challenging experiences of teaching OD. In this way, the interviews supplemented the desk study. Using open and closed questions, the interviewees were asked to give a detailed description of their OD teaching

activities (main topic/theme, target group, duration, modes of teaching, teaching goal, learning activities, etc.). The interviews were carried out individually, either in person or via Skype. Five partners from the ODEdu project conducted interviews for the data collection. Nineteen OD teachers from different sectors were interviewed, representing 25 teaching activities.

The analysis of the interviews reflects that the majority of the teaching and training activities conducted by ODEdu consortium members take only a few hours or a full day. Courses stretching over days, weeks and months are less common – except in university teaching. The predominant form of teaching is face-to-face, but there are also a few examples of online and blended learning.

The analysis focused on identifying successful and challenging experiences related to teaching OD. Three aspects related to successful teaching experiences were identified across the interviews: relevance, hands-on exercises and the importance of being able to benefit from different competences. First, when asked to give examples of successful experiences with teaching OD, some interviewees emphasised that the content of a teaching activity should be relevant to the participant, and they should be able to see the benefits and potentials of working with OD. Further, to ensure relevance to the participants, it is important that the participants have chosen ‘their problem’ to maintain engagement towards the end-product. For example, one of the interviewees described how – in a course on OD Business Models – she encouraged participants to discuss their experiences and knowledge of OD separately from their understanding of how businesses work. The aim was to contextualise what was being taught and to help them come up with ideas of how to strengthen the value proposition of businesses using OD.

Second, the interviews reflected that hands-on exercises are an important element in teaching OD, e.g. data cleaning, licenses, possibilities and visualisations. It is important that the exercises are not too technical, but that they are relevant to the participants and have a tangible output. For example, a university teacher explained how the most successful teaching activity is the one where students develop their visualisations using Open and Linked data: ‘The actual visualization of their work provides them with a sense of accomplishment that motivates them to learn more about the subject of Open Data’.

The third aspect identified in successful teaching experiences is to benefit from different competences in a learning group. Accordingly, to improve end products and learning outcomes, it is beneficial to compose groups with different competences in regards to OD. According to one of the interviews, this was done with success in the hackathon activities.

In terms of the main challenges, despite the variations in teaching aims, methods and audiences, the analysis found similarities between the challenges described by the interviewees. The following five main challenges were identified across the interviews: First, OD is a complex and abstract concept, which at times causes difficulties defining and communicating the practical usefulness and potential added value of OD. Second, as teaching OD is reasonably new, several teachers highlighted the lack of existing learning materials such as relevant and interesting datasets, supporting examples, successful case studies and user-friendly tools for publishing and visualising

OD. Third, it is a challenge to fight the impression that OD requires technical skills and to connect the technical side to the everyday practice of the target group. However, OD is associated with technical aspects, and thus the concept becomes tangible when participants have programming skills. Fourth, participants often have diverse knowledge and skills, which poses a challenge in teaching and dissemination. Fifth, hesitation to adopt OD is reflected in the limited willingness to open up data sets and recognise the potential and importance of OD. OD challenges people's mind-sets and previous business models.

Summing up, the interviews showed that most teachers apply traditional teaching methods with limited use of PBL elements. However, the successful teaching experiences described in the interviews support that PBL could be a useful approach to teaching OD. Accordingly, a workshop was initiated to further explore the relevance of PBL in OD teaching.

Workshop on using PBL in OD context

Considerable information exists on teaching by PBL. However, it can be difficult to navigate and implement as a newcomer to PBL. Taking this difficulty into account, a workshop was organised with two PhD students from the open and linked data field, three PBL researchers and two ODEdu project members. All participants were from Aalborg University in Denmark. The workshop was developed around the question, 'How can we help a new teacher coming to Aalborg University to design an OD course using the PBL approach?' The workshop lasted two hours and used materials such as paper, pencils and visual models to facilitate dialogue, communication and interaction among the participants. The workshop was video recorded and transcribed.

The following six themes emerged from the thematic analysis of transcripts from the workshop on taking a PBL approach to teaching OD. The first two themes concern the organisation of a teaching activity, whether it is a hackathon, a semester project work or a one-day workshop. First, it is essential to consider the *time frame* early in the teaching planning process. The focus group participants discussed how the available time influences how complex and open the problem space can be framed, and one of the participants argued that 'the shorter the time, the more you sort of need to frame'. The time frame for the PBL process must thus be aligned with the pedagogical approach.

Second, *collaboration and group work* are central to PBL. When organising and planning the context of an OD teaching activity, the composition of groups should be decided. In line with findings from the interviews, the focus group participants discussed how groups could be composed so that different competences match the complexity of working with OD.

The third issue put forward by the participants was whether *teaching should be guided by available data or by a specific problem*. In the first case, a set of available data sets the outer limit for possible questions raised for that specific data set. In the second case, any question can be raised, but the available data may be insufficient and additional data must be collected.

The teacher should also decide whether the process of working with data or actually solving the problem is what forms the *content of the course*. If the process is the centre of the teaching, specific methods should be applied to solve the problem. However, if the course is focused on the end product, optional methods and approaches can be used throughout the course. The workshop participants illustrate this decision by explaining the importance of learning to navigate towards the problem: 'So you could tell people "Well, see you here at three o'clock" or "See you here at three o'clock, but you have to take the bus"'.

Similarly, the *extent of instructor guidance* should be considered in the course design process. Should the teacher take control of the learning by guidance or should the students take a leap of faith into the problem solving. One participant mentions that the teachers 'need to decide how much they want to control and how much they want to delegate to the students. I think that is a basic issue, at least to me' (PBL researcher, workshop).

Finally, the participants mentioned *knowledge about pedagogy*. The participants who were PBL researchers, strongly argued that to design learning activities using PBL, the teacher has to have a sound knowledge of PBL pedagogy.

In summary, a review of current international OD teaching activities and the analysis of the challenges that OD teachers encounter when teaching OD show that (1) most of the current OD teaching practices tend to be traditional and thus lack innovative teaching approaches, (2) there is not a well-defined pedagogical approach to inform the different choices and (3) the successful examples and challenges fit well with the PBL principles. In the workshop, the teacher's role as a designer became evident. Many variables were identified that a teacher should consider when designing PBL teaching activities and a variety of ways to approach the designing of a learning activity.

Relevance of PBL in the context of OD training

After reviewing OD teaching initiatives and educational practices, this section continues with a theoretical discussion of the relevance of PBL to the practice of OD teaching.

PBL fosters not only development of content knowledge but a wide range of so-called soft skills, such as communication and collaboration, problem solving, decision-making, critical thinking, self-directed learning, leadership and teamwork. The skills are similar to those needed in OD (problem solving, storytelling, collaboration, curiosity, communication and creativity; Carreras et al., 2015) and to the so-called twenty-first century skills, which students should master to succeed in work and life in the twenty-first century (within the category of learning and innovation skills: creativity and innovation, critical thinking and problem solving, and communication and collaboration; P21 Partnership for 21st Century Learning, 2015).

Previous empirical research demonstrates the relevance of PBL as an educational approach, in the general educational practice, but also in specific. Wilder (2015) analysed 10 quantitative studies in the context of secondary education and compared the academic achievement of PBL and traditional teaching. Wilder (2015) showed that seven of those studies acknowledged significantly

higher achievement levels among the students using PBL, two of the studies did not indicate any significant differences and one study revealed that the PBL group achieved lower scores. Within the higher education context, researchers have found that PBL has no significant effect on knowledge but has a significant impact on soft skills; furthermore, PBL students have the competence to integrate the knowledge acquired into practice and into different contexts (Capon & Kuhn, 2004; Dochy, Segers, Van den Bossche, & Gijbels, 2003). Within the field of computer science and computer engineering, several studies (Barg et al., 2000; Coto, Mora, & Lykke, 2013; Coto, Mora, Lykke, Vandell, & Jantzen, 2014; Prince & Felder, 2006) have described the implementation of PBL to overcome problems in the field such as a pure technical focus, individual learning, a deductive teaching approach, high percentage of dropout, high failure rates, lack of competences needed by the industry and a lack of intrinsic motivation. Finally, research within the field of open literacy, closely related to the field of OD, argues for the use of PBL as an approach to develop data literacy skills because, combined with real world data, this approach fosters “higher order thinking, connects procedure to practice, and helps bridge the gap between learning facts and acquiring inquiry skills, critical reasoning, argumentation, and communication” (Ridsdale et al., 2015, p. 13).

PBL focuses on integrating theory and practice (Savery, 2006). In this understanding, knowledge and learning are contextual and situated. Participants conduct research, use theory and apply knowledge to solve a problem in a certain context. This contextual and situated quality of PBL is highly relevant to the OD field because OD aims to create new knowledge and applications to solve real-life problems. Accordingly, this aspect of PBL will respond to the need of teachers for a relevance of OD training.

Within PBL, problems are complex, ill-structured, open-ended and authentic to promote students engagement, discussion and argumentation and to stimulate self-directed learning and multidisciplinary solutions (Hmelo-Silver, 2004; Moust, Van Berkel, & Schmidt, 2005). The discussion and debate during the process of problem solving support higher order thinking and promote knowledge sharing and knowledge construction and construction of common explanations (Hmelo-Silver, 2004). The competences developed by PBL fit well with the skills required to work with OD, furthermore, it deals with the teachers’ need and challenge about involving different perspectives and different backgrounds. PBL offers the relevant aspects of working with real problems, solving complex problems in multidisciplinary teams, thinking critically and creating relevant contextual knowledge.

In summary, the five core principles of PBL (problem centred, collaborative learning, critical thinking, self-drive and reflection) deals with most of the challenges presented in the OD teaching practices presented in the previous section, and the approach can potentially leverage the successful practices and experiences of teaching OD. The challenges to design OD training using PBL will demand that the teachers re-think how they teach as well how students learn. This process may bring innovation to the teaching practice, as well as innovation in the outcome of the teaching activities (Irons & Thomas, 2015). However, the proposal to adopt PBL to develop OD training is not a simple solution because existing literature shows that pedagogical innovation is a challenge for

teachers (Conole, 2013), as well as the adoption of PBL (Ertmer & Simons, 2005). The following section argues that teachers need to be supported in their learning design process. This argument was identified in the workshop, but it is also a request if we aim for innovation in the teaching approach.

Teacher as designer

Designing the learning activity requires teachers to manage a considerable amount of information from many different sources (students, university, pedagogy, experience); thus, the teacher should experiment with the interactions between many elements and hold a constant dialogue between the content and the pedagogy to find a feasible way to design the OD course while applying the PBL approach.

The overall situation is complex because, on the one hand, the teachers are in a changing field that is regularly updated with new technologies, and on the other hand, the teachers can benefit from implementing active learning and student-centred approaches, such as PBL. Such approaches are complex and require teachers to change their ways of thinking and acquire new knowledge about the pedagogical approach.

Ertmer and Simons (2005) argued that most of the novice PBL instructors are likely to encounter difficulties when planning, implementing and assessing PBL, stating that without adequate support, the adoption of PBL methods is likely to be extremely limited. Therefore, there is a need to support teachers with a wide variety of sources that enable them to cope with the diverse challenges. Ertmer and Simons (2005) also argued that teachers need new tools and strategies to support their adoption of new roles and planning of PBL activities, which led us to find a way to support OD teachers' adoption of PBL as part of their teaching practices. Accordingly, we define a profile of a teacher with experience in OD, but a novice in PBL and with the need to become a learning designer.

Recently, educational research communities have highlighted the need to view teachers as designers. Design is often described as an ambiguous, ill-defined problem, which involves many possible solutions (Cross, 2011), several decisions (Auriscchio, Ahmed, & Wallace, 2007) and questions in the form of deep reasoning questions and generative design questions (Eris, 2003). Within the field of software development, Winograd (1996) defined design as a conscious, creative and communicative process, a dialogue with material and a social activity, which has social consequences and keeps human concerns in the centre.

Beetham and Sharpe (2013) stated that design is relevant to teaching practices because design bridges theory (principled approach) and practice (contextualised and in continue change practice), and they argued that design activities have a high value in the knowledge and digital society. Laurillard (2012) claimed that teaching in line with design professions aims to change and transform the learner's mind; therefore, seeing teaching as a design science will promote the creation of knowledge not only by educational researchers but also teachers (practitioners). Conole (2013)

considered that design enables teachers to develop more effective learning environments by supporting teachers to make informed decisions about new technologies and innovative approaches that can respond to the current educational context.

According to Conole (2013), learning design encompasses the process of designing learning experiences and the outcome of the design process. It helps teachers make informed choices regarding learning interventions and it can support teachers to document and share their ideas and products with other teachers.

Principles and challenges of teacher as designers

Reviewing the literature within this field, we identify four common principles that support teachers as designers: (a) the learning designs should be sharable and understandable, (b) the design process should be explicit, (c) teachers' design practice should be community based, and (d) teachers should be able to learn and improve by reflecting on their process and products.

The principle that learning design should be sharable and understandable relates to how teachers should effectively describe teaching ideas so they can be shared with and adapted by other teachers (Dalziel et al., 2016). Regarding the design process, Conole (2013) argued that an explicit design process enables teachers to develop more effective learning environments and helps teachers to end with a more explicit and sharable product. The need to have an explicit design process and understandable and sharable results that are closely related with the principle of working as a community. According to Laurillard (2012), teachers need to build on the work of others, innovate, test, improve and share through a continuous cycle to develop the discipline of design within teaching. Finally, teachers as designers should reflect and create knowledge to improve learning environments and interventions for learners (Conole, 2013; Laurillard, 2012).

However, we identified four main challenges that teachers face when becoming designers for learning. First, the huge amount of information and tools available and the lack of teachers' skills required to use them for teaching and learning is a serious challenge that hinders teachers' abilities to integrate those resources into engaging learning environments (Conole & Wills, 2013; Laurillard, 2012; Mckenney, Kali, Markauskaite, & Voogt, 2015).

A second challenge is the lack of necessary design skills to make informed learning interventions. According to Conole and Wills (2013), teachers lack the design skills needed to create or adapt educational resources to their teaching. Conole (2013) argued that teachers 'do not know how to design and they mainly adopt an implicit approach based on previous experiences and practices' (p. 102). Therefore, there is a need to support and guide teachers to think differently and change their design practice from that of an implicit and belief-based approach to an explicit and design-based approach (Conole, 2013; Conole & Wills, 2013).

The third challenge is the lack of frameworks and structures to support the design activity. Conole (2013) called for a more formal approach to design for learning, which is a 'more systematic, explicit design approach, drawing on empirically derived and validated tools and methods for design' (p. 6). One of the recommendations in this regard is the power of visualisation to provide a means to guide the design process (Conole & Wills, 2013) and the use of design thinking tools such as drawings, prototypes and imagination (Cross, 2011; Lawson, 2005).

As a combination of the previous challenges, the fourth challenge is the gap between novice and expert learning designers. Dalziel et al. (2016) stated that experienced teachers might be able to make judgements about the design process without needing detailed descriptions or information, while novice teachers likely need more guidance. The general design field suggests that novice designers require structure and organising principles, guidance from skilful teachers, exposure to many successful examples to draw on and support from a community (Ahmed, Wallace, & Blessing, 2003; Cross, 2011; Lawson, 2005).

Despite the existence of research work in this field and the increased referral to the teacher as a design professional, this is an incipient field lacking practical and concrete design processes that can guide novice teachers to adopt a new specific pedagogical approach. We thus identified a need to support OD teachers by developing a visual, structured and simple model to guide them through the adaption and implementation of PBL and foster their competences as learning designers.

OD-PBL Pathway

The proposed pathway for OD teachers is developed based on theoretical knowledge of teachers as designers with insights from the empirical work presented above. The proposed pathway is aligned with Conole's (2013, p. 131) proposal of a learning design methodology. The OD-PBL pathway is pragmatic (useful tool for practitioners to address OD educational challenges), theory driven (recognises the complex, messy and diverse field of PBL, but extracts key principles for novice PBL teachers), collaborative (encourages the OD teachers' community to support each other), iterative, adaptive and flexible.

The pathway includes three main elements: (1) a call to approach the teaching activity with a design thinking mind-set, (2) a concrete and visual design process, and (3) a set of proposed methods to support each step in the design process. Figure 1 shows the overall model.

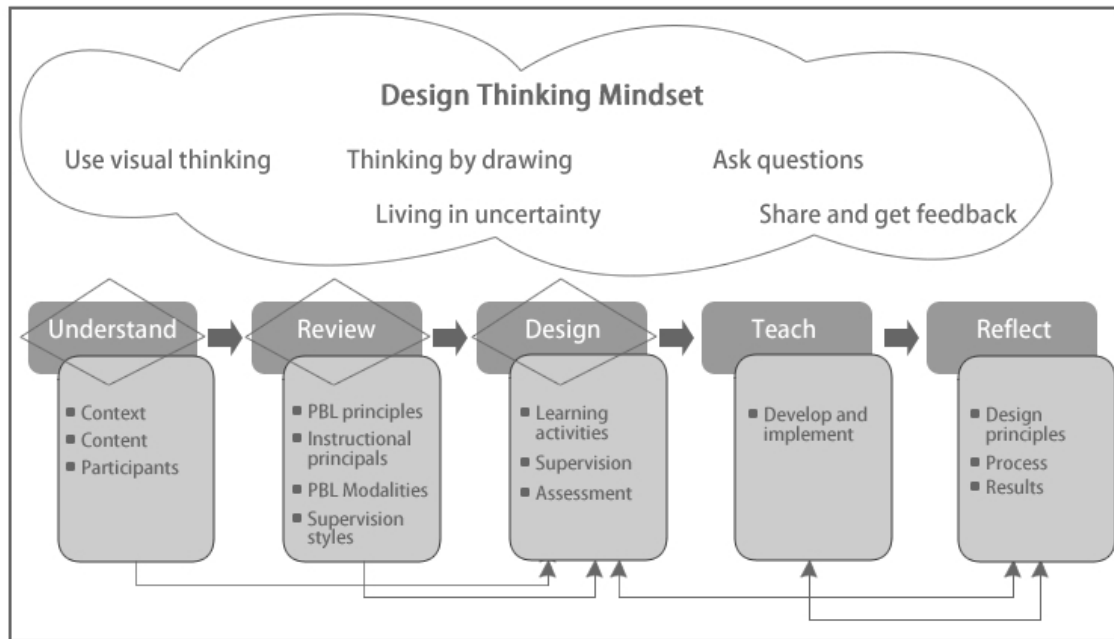


Figure 1: The OD-PBL pathway. A pathway to adopt PBL as teaching approach in OD education.

Design thinking mind-set

Based on the literature and the findings from the interviews and the design workshop, we identified the need to be explicit about the mind-set that teachers should cultivate to innovate their teaching practices by using PBL and information and communication technology (ICT). The OD–PBL pathway (Figure 1) lists five ‘designerly’ ways of thinking in the cloud at the top that should be explicitly fostered among teachers to enable them to become learning designers.

- (1) **Use visual thinking:** Visualisation is the process of producing ideas or representing data into maps, images and/or stories in two or three dimensions to communicate and discuss that information. As defined by Goldschmidt (1994), ‘visual thinking is the production of thought via visual imagery’ (p. 161). Imagination is thinking about a situation that is possible but not real at the moment; it requires envisioning the future. Visualisation facilitates the understanding of complex things that are difficult to express with words and can represent complex situations in a page (Roos, 2006).
- (2) **Thinking by drawing:** This is one of the most needed skills that teachers should practice to become learning designers. According to Cross (2011), ‘designers need to use sketches, drawings and models of all kinds as a way of exploring problems and solutions together, and of making some progress when faced with the complexity of design’ (p. 37). The use of drawings helps to clarify thoughts and the internal mental process as the designer externalises his ideas. Once the ideas are put onto paper, the designer can interact, criticise, discover and create using those internal ideas (Cross, 2011).

- (3) Asking questions: Asking questions is a design activity that improves progress. Asking questions is part of the convergent and divergent thinking within the design activity. Eris (2003) referred to two kinds of questions: deep reasoning questions (convergent thinking), which aims to understand facts, and generative design questions (divergent inquiry), which create possibilities from facts.
- (4) Living in the area of uncertainty: The designer should be able to cope with moving on with ambiguous and uncertain proposals for long a time.
- (5) Sharing and getting feedback: Different to the teaching activity, design is a social activity rather than an individual activity. Cross (2011) referred to the design process as 'necessarily social and requires the participants to negotiate their differences and construct meaning through direct, and preferably face-to-face, exchange' (p. 31). The teaching activity is quite individual and the recommendation is to attempt to share the design process and the outcomes with others.

The design process model

This study adopted an overall design process (analysis, design, implementation and evaluation) using labels from the field of educational design. The process presented is a linear sequence; however, the process must be understood as an iterative activity that goes back and forth between the steps. We also see this design process in the way that Cross (2011) described it, as the relationship between the problem and the solution. Designers recognise how the two elements interweave and develop together. In this process, the teacher might move on with tentative solutions that may be open and inconclusive for a long time, while remaining in the process of making sense of the problem.

Step 1: Understanding

Phase one involves understanding where the teaching parameters are discussed and defined. This first step supports the designer in knowing the context, content and participants to define the design challenge.

Context: The OD project contains three general contexts where the learning activity could take place: university, private companies or public institutions. Each of these sectors has a set of values, rules, assumptions and characteristics that would influence the design of the learning processes. Furthermore, the context aspect takes into consideration the institution's organisational culture (e.g. explicit and implicit moral values, political and spiritual values etc.). When examining a particular institution, it is important to consider not only the concrete aspects of the physical and virtual environments available for teaching and learning but also the characteristics of the learners and teachers. Within this context, it is important to understand the time available for the design process.

Content: The designer is presented with a set of options regarding the content of the course. The designer has three options: (1) content given by the institutional curriculum, (2) a list of the users' needs, or (3) a set of desired competences to achieve.

Participants: The participants are the most important aspect to consider in step 1 because PBL is a student-centred approach; thus, it is necessary to get to know the participants to respond to their needs, concerns and desires.

The designer should be able to understand the interdependence between the context, the content and the participants to define the learning goals of a specific activity and move to the next step.

Step 2: Review pedagogical principles

Phase two reviews the key PBL concepts and design principles. This step aims to guide the teacher through a more informed design process regarding pedagogy because they need to have clear design principles to start the design phase. Here, the teacher-designer explores two sets of design principles: the meta-principles and the pragmatic principles. The meta-principles are the core of the PBL approach and comprise the following elements: problem-centred, collaborative learning, critical thinking, self-driven learning and reflection. The pragmatic principles are more instructional design-oriented and include activation, demonstration, application, integration, feedback and communication (Margaryan, Bianco, & Littlejohn, 2015). Furthermore, the teacher should get a clear understanding of the different modalities of PBL and the elements that should be aligned. Finally, the teacher should refresh the knowledge about the different ICT tools that can be used in their teaching to achieve the learning goals.

Step 3: Design

This phase is where the core design activity takes place, and we suggest using design materials (paper, post-it, pencil). The teachers should use most of their design skills to create a learning design that responds to the learning goals. In this phase, the designer should decide and design the PBL modality, the problem, the learning activities that support PBL principles and the instructional principals, the assessment, the supervisor role, and check that the overall design aligns with PBL and the learning goals.

The final product of this phase is the 'course description' which includes aspects such as the knowledge, skills and competences to acquire, and the schedule, learning activities, assessments, and course literature.

Step 4: Teach

In this phase, the learning activity is implemented. For many courses, mainly in the university context, the design is implemented gradually; therefore, the teacher may begin implementing the actual design as the teaching time progresses. Because of this characteristic, this is an

iterative phase because the design is implemented into the real setting and the teacher needs to reflect and modify the design according to the participants' responses and the context.

Step 5: Reflect

This step aims to develop teachers' reflective practice. The goal is that teachers reflect on their design and the outcome of the implementation (teaching) to create a culture of continuous learning. The teachers should critically reflect on the PBL approach, the activities implemented, the assessment and the students' responses. Teachers should also evaluate the achievement of the learning goals stabilised in step 1. This reflection step is part of 'learning how to learn' and being able to communicate the learned lessons to the OD community.

Proposed methods

A variety of design methods exist that can be used in the different design process steps. Table 1 proposes some relevant methods for each step in the OD-PBL pathway including a brief description of the methods and how they could be used. Table 1 also includes a citation for each method so that readers can explore the different methods further.

Table 1

Proposed Methods for the Design Process

Step	Method	Description	References
Understanding	Business origami	This method creates a map of the different people, artefacts, environments and technologies that form a system, in this case the context of the OD.	Martin & Hanington Bruce, 2012, pp. 24–25
	Concept Map	This is a visual tool that can help to generate ideas and identify the key concepts and skills from the teaching activity. The tool helps to define the relationship between the course elements and organise the course content.	McDaniel, Roth, & Miller, 2005
	Empathy map	This method provides a good understanding of the person for whom the teacher is designing and will help to develop empathy. This tool can be used to determine the participants' needs.	Ingle, 2013

Review Pedagogical Principles	Inspiration cards	These are cards on which an image, a title and a reference are printed. We recommend creating inspirational cards for PBL principles, instructional principles, modalities of PBL and supervision styles with PBL.	Halskov & Dalsgård, 2006
Design	Brainstorming	This method aims to generate as many ideas as possible about learning activities to support PBL principles, instructional principles and assessment activities.	(Hyerle, 2009)
	Card Sorting	This is used to organise information into categories and provide a structure. Using the concept cards from the previous phase and the ideas generated in the brainstorming activities, the teacher sorts out the activities under the different principles.	Wood & Wood, 2008
	Learner journey map	A customer journey map is a combination of visualisation and storytelling that represents the process that a person goes through to accomplish a goal. Here, the teacher could create a 'learner journey map' to guide the participants from the current state to the desired state.	Kaplan, 2016
	Check list	This is a kind of rubric that the teachers develop to check the design against the design principles and the learning objectives. This checklist may have questions such as 'What kind of PBL am I applying?' 'Is this problem related to real workplace problems?'	
Teach	Diary studies	For the two last steps, we propose the same method. During the teaching step, the method aims to collect information from participants and/or teacher over time. They can add information about	(Martin & Hanington Bruce, 2012, pp. 66–67)

		their thoughts, feelings, behaviours, etc. The teacher can use the tool to keep a record of their teaching activities as they are implemented over time.	
Reflection	Diary studies	In the second part, the teachers analyse the information collected during the previous step. Here, the method is use as meta-reflection technique that aims to foster self-awareness, thinking, analysis and learning.	(Leitch & Day, 2000)

Conclusions

The paper investigates the current OD teaching practice and found that the practice is guided by a traditional teaching approach (lecture-based). We argue that PBL is a potential pedagogy for teaching OD; however, the teachers would need some kind of scaffolding when adopting this approach for the first time. We thus propose a concrete design process and recommended some design methods to support novice teachers in their design of OD teaching activities.

Pedagogical innovation can be quite demanding, the process and outcomes of the first experience are relevant for continuing the process. The OD-PBL Pathway helps teachers who are new to the fields of design and PBL to develop their expertise.

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