

Analysing and supporting the process of co-designing inquiry-based and technology-enhanced learning scenarios in higher education.

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Abstract

This paper is framed within a research project on the co-design of learning scenarios in higher education. Co-design is understood as a creative process developed collaboratively by teachers, students and researchers to design inquiry-based and technology-enhanced and networked learning scenarios. In this process, methods and instruments from the field of participatory design and learning design are used. Among other things, the co-design process involves discussing and negotiating the design principles to be used on a shared basis in order to devise the learning scenarios. These design principles are based on recent approaches to the model of inquiry-based and networked learning.

The study applies the methodology of design-based research. The object of study is therefore the very process of co-designing, taking as key agents both the teachers and the students to whom those practices are addressed. A mixed approach is used for data collection, analysis and interpretation.

It is the purpose of the research to develop instruments that support the co-design process and products through its representation and explanation. Several design tools and conceptual artefacts are used to guide practitioners in the creation of a common “language” and help them to reflect and to represent practice during the co-design process. Furthermore, a co-design methodology is proposed and applied in a cycle starting from the problematisation of the learning practice towards the creative envisioning of multiple solutions and the operationalisation of one of these solutions as a learning scenario.

In particular the paper reports the first phase of the research which analyses the co-design work developed with a group of teachers from universities with two different models, one of them blended and the other virtual. Firstly, the theoretical framework is developed to highlight the theoretical and practical interactions between participatory design methods and tools and the domain of learning design. Secondly, the research design is described and a model is proposed for the analysis of the co-design process of inquiry-based and technology-enhanced and networked learning scenarios. To conclude, we discuss the major implications and challenges of this approach.

Keywords

Learning co-design, learning scenarios, representation of practice, design patterns, technology-enhanced learning, inquiry-based learning, higher education.

Overview and rationale of the project

Learning activities at universities, whether mediated by ICT or not, are generally inauthentic and decontextualised and not really focused on the students. In many areas transmissive methodologies are still favoured, orientated to individual work and mainly focused on contents and summative assessment tests. This, among other factors, has led in recent years to a sort of disaffection on the part of students towards learning at

university, as there is a gap between their expectations and reality, in a context that does not take into account their outlook, specific needs and interests. Several authors have referred to the gap between the potential of technology and its actual use in educational contexts (Conole, Dyke Oliver, Seale, 2004; Strijbos, Kirschner & Martens, 2004), as well as to the need to provide guidance in the design of learning activities about choosing the right tools and how to use them based on certain pedagogical approaches (Conole, Oliver, Falconer, Littlejohn & Harvey, 2007; Conole, 2008).

Moreover, various studies seem to agree that most teachers use design approaches implicitly based on experiences and past practices, but not based on intentionally articulated and theoretically grounded principles (Conole, 2013; Craft & Mor, 2012). A key and unresolved issue is how to help teachers make informed changes in teaching and learning processes, without requiring them to immerse themselves in educational literature. Conole (2013) highlights some of the findings of OULDI (Open University Learning Design Initiative) in analysing learning design practices by teachers. A series of inherent contradictions and tensions can be detected in this type of process: a) there is a tension between the conception of design as a process and as artefact or product, both are considered important, although the latter tends to prevail over the first; b) it is difficult to capture and reflect parts of the design process that are implicit; c) teachers prefer to work from case studies and examples; d) the type of representations used in the designs, as well as subjective interpretations may vary and depend on various factors; e) teachers prefer specific support and assistance regarding the design process at the precise moment that this is needed (just-in-time).

The field of learning design has developed in recent years and now offers a set of methods, tools, systems and models (McAndrew & Goodyear, 2007; Masterman & Vogel, 2007; Craft & Mor, 2012) that can empower teachers in the design of scenarios that provide richer learning experiences. Despite this, various authors agree it is still an underdeveloped field of knowledge that is slightly systematised and standardised. Therefore it still has a relatively low number of tools and instruments of representation, and so its language is still limited to supporting the development and sharing of design tasks. Moreover, some researchers are critical of recent developments in the field of learning design that focus solely on supporting the orchestration and sequencing of activities to streamline their administration (Falconer, Finlay & Fincher, 2011). The claim is that to design technology-enhanced and networked practices aimed at supporting teaching and committed to the professional development of teachers, it is essential to provide “effective ways of good and innovative practice representing that facilitate its sharing and reuse” (Vogel & Oliver, 2006). Falconer, Finlay & Fincher (2011) sustain that in order to be effective, representations must convey the information teachers need in a way that they can understand. This implies capturing what these authors called “intrinsic aspects of teaching”.

Given this reality, the Design2Learn project aims to study the development of learning scenarios that are more authentic, contextualised and focused on learners, through a co-design process involving students and teachers in the negotiation of the design principles of such scenarios. The design of scenarios –including the sociocultural context in which they are framed, the chosen pedagogical approach and the objects that make up the learning situation– in which learning activities are inserted can elicit the processes intended to be facilitated and promoted among students. Therefore, this research is based on three assumptions:

- a) students’ participation in the co-design process can integrate their perspective, interests and needs more effectively, ultimately promoting deeper learning by different student profiles and in different learning contexts.
- b) co-design processes involving students and teachers in collaborative negotiation of the design principles applied to learning scenarios can facilitate the adoption of an inquiry-based learning model mediated by a more mature and autonomous use of technology by students in open and networked environments.
- c) co-design processes can be facilitated by collaborative and participatory dynamics, supported by different types of instruments for representing teaching and learning practice, such as design patterns, case stories, storyboards and diagrams.

Learning design must be anchored in a specific practice context, yet be rigorous in paying attention to empirical evidence and pedagogical theory, and still be creative in its approach to generating new solutions to educational challenges (Craft & Mor, 2012). In this sense, the adopted research methodology is the design-based research, which allows a collaborative approach to generate practice-based knowledge. This collaborative approach involves actively engaging the educational scenario agents of change in the research process. The theoretical and empirical background for these approaches is described and a model for the analysis of co-design processes is proposed. Finally, the implications of the application of this model are discussed.

Theoretical background

From participatory design to learning co-design

In the bigger picture drawn by the field of participatory design, similar notions such as co-creation, co-production and co-design converge. In general, all these terms refer to actions of collective creativity and co-creation of knowledge. In the social and educational domains, methods of co-design have recently started being used. Its application is related to participatory approaches and collaborative research, but it clearly derives from the discipline of participatory design, which has been especially developed and implemented in fields such as architecture, engineering, computer science and human-computer interaction (HCI). The common element in all these fields of application is the analysis of the active and joint participation of different actors involved in the use of certain methodologies, products and/or technological tools, which allows the phenomena associated to this use to be traced and interpreted.

Two different traditions can be identified in the field of participatory design that currently influence each other, the Scandinavian and the North American. The evolution of both approaches has resulted in a growing trend towards designing experiences rather than products. The complexity of this task is increasingly associated with the user account as a partner and less as a subject (Sanders & Stappers, 2008). Participatory design should not be understood as the mere involvement of participants; what matters is how and who negotiates participation. Participation, from this perspective involves stakeholders jointly researching, reflecting on, understanding, establishing, developing and supporting each others' learning processes throughout the design process. The collective reflection in action reverts to all participants in the form of increased knowledge and understanding of the context, practices taking place and the designed "objects" (Robertson & Simonsen, 2012). It is considered that by using this approach not only will the "designed products" be more readily accepted and integrated, but they will also be more flexible and more robust in use, accessible to a larger number of people, and more adaptable to changing conditions over time. Teamwork and collaboration are key components of participatory design processes, which are based on collective input to bring out different ideas and alternative strategies that respond to the needs and problems being addressed.

Regarding the educational domain, the most common approach has been to involve teachers in the co-design of actions, methods and products to support learning. In this context the concept of co-design is used to name the participatory approach to learning design. This approach has allowed the development of innovations rooted in real contexts of teaching and learning, facilitating the ownership of new tools and strategies and promoting deep transformation of educational practices. In these situations, educational needs and problems arise as open and complex issues that require a global approach. Thus, participants are invited to stake a diversity of perspectives and strategies to develop various possible solutions. Many of the co-design practices in education are associated with the design and implementation of technological tools to support learning processes (Mor & Winters, 2006; Roschelle, Penuel & Schechtman, 2006; Penuel, Roschelle & Schechtman, 2007; Hannon, Danahi, Schneider, Coopey & Garber, 2012). There are also some experiences and research in which the object of design could be the curriculum, for instance the learning materials of a particular subject or a methodological model (Shrader, Williams, Lachance-Whitcomb, Finn & Gomez, 2001; Könings, Brand-Gruwel & Van Merriënboer, 2011). In general, it is about funnelling educational innovations that currently involve the use of technological resources in the school context, i.e., primary or secondary education. These experiences have typically involved teachers, researchers and often software developers, as partners in the process of co-designing educational innovation. Participatory, collaborative and practice-based research approaches such as design-based research have been generally used in these studies. This methodology ensures the connection and the orchestration of the theory, practice models, tools and participants insights.

Roschelle, Penuel and Shechman (2006:607) mention seven characteristics to be met by the application of co-design methods. Although few cases of the application of learning co-design can be found in the literature, a review of some of them has allowed us to identify the common elements of the applied methods (Zaphiris, Laghos & Zachari, 2005; Shrader, Williams, Lachance -Whitcomb, Finn & Gomez, 2001; Freire & Villar, 2009, Allert & Richter, 2009; Garcia & Gros, 2013), which we list below, based on the proposal of Roschelle et al (2006), with the aim of completing it:

- a The co-design process involves a concrete and tangible innovation challenge.
- b It is developed in the framework of practice-based research approaches, overall design-based research, participatory research or formative research.
- c The design purpose or goal is flexible and can vary in different iterations.

- d It requires a shared experience that catalyzes teamwork processes and generates a basis of common ground or understanding.
- e It must comply with and respect the cycle and the rhythms of the real context of application.
- f It requires strong facilitation by the drivers of the process and well-defined roles for all participants, who can maintain different levels of intervention and therefore different levels of decision-making capacity or influence in the final design.
- g It requires clear distribution of responsibilities for the quality of the co-designed products.
- h Although it can be developed through face-to-face and/or virtual processes, the former seem to contribute more clearly to strengthening the relationship between the team members and facilitating mutual understanding.
- i The complexity of data collection and analysis throughout the process involves putting into play strategies and instruments of different methodological approaches and disciplinary areas (ethnographic, statistical, conceptual and graphical representation, etc.), which contributes to increasing the objectivity, validity and applicability of the co-design process and its products.

As for the stages of the process, the analysed experiences coincide to integrate four key moments or phases. The same design sequence is always repeated or iterated several times in a process of joint assessment and analysis by the co-design team, until it is decided that the designed product is optimal.

1. Exploration phase: there is a diagnosis of educational practices and spaces involved, in order to develop an idea about the real needs of the context.
2. Envisioning phase: this involves anticipating solutions to the problem posed to foresee or imagine what is intended to be designed, clarify the goals and values of the participants and agree on the desired outcome.
3. Operationalisation phase: the solution envisaged in the previous phase is translated into a tangible work product or prototype, which can be implemented and evaluated.
4. Assessment and reflection phase: the iterative implementation of the prototype and its systematic evaluation allows assessments and impressions to be collected in the real context for the review of the design and the restart of the cycle.

The research reported in this paper aims to study and accurately document a process of co-designing learning scenarios, including its articulation, roles, components, phases, conflicts and turning points. The purpose is to assess the potential of this approach as a catalyst for change and innovation in higher education.

Supporting co-design through representations of practice

As we have outlined above, the task of learning (co)design is complex. The design should articulate and orchestrate the disciplinary content, pedagogical theory, experience based on practice and the use of increasingly diverse and sophisticated technological resources (Rohse & Anderson, 2006; Goodyear & Retalis, 2010).

The design is by nature iterative and collaborative. It requires discussion, reflection, critique and implementation, so it works better in teams in which there is a complementarity of skills and knowledge. Being a cognitively demanding task, it requires tools and representations that allow for abstraction to be managed and understood (Goodyear & Retalis, 2010). That is, it must be provided with ways to describe and represent learning activities so that they can be easily understood and shared by teachers and designers. Agostinho (2006) puts it in the following terms: “a representation of teaching and learning practice in some notational format documented so that it can serve as a model or template adaptable by a teacher to suit his/her context”. Conole (2008) proposes the concept of “mediating artefacts” of the design process, from a sociocultural perspective of learning, to refer to this type of representation instrument. According to the author, these forms of representation act as mediators since they support and guide informed decision-making in the process of designing and implementing specific learning activities. These representations allow the properties that make one practice effective to be abstracted in different contexts, but at the same time they enable the essential elements for the proper implementation of this practice to be captured.

These representations of teaching practice can adopt many forms and therefore have different properties. Examples of simple representations of practice are narratives or case stories, design patterns, diagrams and concept maps or other forms of visual presentation, vocabularies, models, etc. (Conole, 2008). Falconer, Finlay

and Fincher (2012) perform an inspiring analysis of the characteristics of different representations of practice, as they allow or not the integration of: a sequence of activities, an approach based on problem-solution, critical success factors and non-sequential knowledge about practice. These authors criticise the learning design approach that exclusively focuses on the sequential representation of the activities and the orchestration of their components. In their opinion this approach overlooks the nuances of teaching practice and the contingencies in the implementation of the designed activities in a real context. In fact, they conclude that the representation of practice is complex and contextualised and that no instrument by itself is entirely adequate.

We agree with these authors that in order to adopt new practices, teachers must be able to visualise themselves implementing such practices. Supporting them in this task involves accompanying them in the process of design and providing them with instruments that allow the representation of the tacit, experiential and contextualised knowledge encapsulated in a specific design. Such representations may, in general, be distilled or derived from other learning activities through an abstraction process taking place in the very process of co-design. That is, the same experience of co-design can integrate the generation of effective representations of practice, which then may be used by the participants in the co-design process.

In the project discussed here, different representation tools are used to support the co-design process: narratives or case stories, design patterns, storyboards and diagrams, the latter based on the use of the Compendium LD program. The intention is to combine these tools to obtain a more holistic representation of the practices of inquiry-based (IBL) and technology-enhanced/networked learning (TEL/NL) to facilitate the co-design of innovative learning scenarios in eight different contexts of practice.

These representation instruments are used at specific moments of the co-design process in order to scaffold the work dynamics involved in each phase. The co-design methodology used is based on the “participatory workshops pattern” proposed by Mor, Warburton and Winters (2012) for the collaborative creation of design patterns. Thus both design patterns and other representation instruments are built on and along the co-design process based on a set of design principles that are jointly shared and negotiated. The intention is that this participatory and collaborative methodology will facilitate the exchange of practices among the participants as well as the extraction of the key elements for the design of innovative and networked learning scenarios that are more situated, authentic and effective.

Despite the numerous documented benefits of using design patterns in education, there is still little evidence of their acceptance and use among teachers (Goodyear & Retalis, 2010). The most common barriers to their use, associated with learners or practitioners, are based on relevance, accessibility and format. However, we can also find an important effort in addressing the problem of making patterns more accessible to users (Laurillard, 2012). Similarly we have referred to other objections about the effectiveness of certain instruments of learning design to represent teaching and learning practice (Conole, 2008, 2013; Falconer & Littlejohn, 2006; Falconer, Finlay & Fincher, 2012). This research aims to identify in what circumstances and for what purposes the tools of representation, sharing and reflection used are more and less useful to support the co-design of learning scenarios in higher education.

Methodology

The study applies the methodology of design-based research. The design of the investigation is iterative, situated and intervention-led but underpinned by theory. The object of study is therefore the very process of co-designing, taking as key agents both the teachers and the students to whom those practices are addressed. A mixed approach (quantitative and qualitative) is used for data collection, analysis and interpretation.

Table 1 outlines the research plan, the co-design activities undertaken and the research tools applied in each phase. The research design involves several cycles of iterations with the aim of refining the process of co-design. In this contribution we focus on the results obtained in the first phase of the process, which is highlighted in Table 1.

The research questions for this first phase are as follows:

- 1 What is the role of representation instruments in supporting a co-design process (case stories, design patterns, storyboards and diagrams) of IB and TE/networked learning scenarios?

- 2 How are participants' roles and levels of intervention negotiated, assigned and managed throughout the co-design process?
- 3 What are the stages and critical issues to consider in the process of co-design?

The participants are a group of teachers from two universities with different models, one of them blended (University of Barcelona) and the other virtual (Open University of Catalonia). Of the four mentioned contexts reported in this study, two are from the blended university and two are from the virtual one. The four design contexts correspond to different disciplinary areas, such as medical informatics, economy, tourism and communication. The co-design of a learning scenario for each context of practice aims to ensure that results are accessible, acceptable and useful to all participants, and can be effectively used to evaluate, report and improve practice in these and other contexts (Anderson & Shattuck, 2012).

Table 1: Research plan Design2learn project

RESEARCH PHASES	DATA GATHERING
PHASE 1. Preparation of the research team (January –July 2013) Literature review and elaboration of the theoretical framework Elaboration of the research design and instruments	
PHASE 2. 1st co-design cycle in 4 contexts (Sept 2103- July 2014) 1st stage: Informed exploration and ideation of the learning scenarios Participants: teachers and researchers - Generation of case stories and design patterns. - Prototyping the learning scenarios through storyboarding. - Visual representation of design scenarios through CompendiumLD.	- Initial interview with teachers. - Participant observation and audio recordings of joint work sessions. - Short questionnaires after each joint work session. - Field notes.
2nd stage: Enactment of the learning scenarios and assessment Participants: teachers, students and researchers - Review and discussion on design principles, design patterns and prototyped scenarios with students. - Implementation of design patterns and prototyped scenarios, feedback and collaborative assessment (at least two iterations).	- Initial interview with students. - Participant observation and recordings of joint work sessions. - Short questionnaires after each joint work session. - Classroom observation and field notes. - General survey to whole student group.
3rd stage: Final evaluation and systematisation of the designed learning scenarios. Participants: teachers, students and researchers - Assessment and systematisation of the designed learning scenarios. - Assessment and systematisation of the co-design instruments and methodology.	- Final interviews with teachers. - Discussion groups with students.
PHASE 3. 2nd co-design cycle in 4 contexts (Sept 2014 – July 2005)	Repetition of stages 1 to 3
PHASE 4. Broader impact evaluation (Sept– Dec 2015) Participants: teachers and researchers - Analysis of the intervention in multiple contexts to improve theory on learning co-design methods and representation instruments.	Triangulation of data from 8 contexts of practice, interpretation and elaboration of conclusions.

The first phase of the co-design process (Phase 2 - Stage 1 in Table 1) consists of a series of six participatory workshops. More specifically, the dynamics consist of facilitating small group work and creating spaces for plenary sharing and feedback exchange. In this co-design phase, six teachers from the selected practice settings are involved, along with members of the research team. In all, around 12 participants exchange their experiences of teaching practice in the field of inquiry-based learning and technology-enhanced/networked learning.

The first three sessions are based on the methodology of participatory workshops for the development of design patterns. These sessions, –focused on the analysis of best practices for generating design patterns– have the function of introducing participants to the dynamics of co-design and gaining a deeper understanding of the contexts of practice. The aim is to facilitate the abstraction of design principles, which will be documented and systematised in the form of patterns, so that they can be used as supporting and guiding materials in the process

of co-design. The next three workshops are more directly orientated to designing learning scenarios based on inquiry-based learning and technology-enhanced learning principles, following the characteristic phases of a participatory design process, as has been outlined above. This second round of workshops involves prototyping the learning scenarios designed by means of the storyboarding technique and the use of the Compendium LD program to support their visual representation.

Throughout this entire process exhaustive data collection is performed using three different research instruments (see Table 1). The purpose is to thoroughly keep track of the co-design process, enabling us to answer the research questions that were posed. To do this, we have developed an analytical model that integrates all the meaningful dimensions for studying the co-design according to the literature review and research questions. Specifically, the relevant dimensions for the study reported in this paper are: *methodological aspects, LD representation instruments (case stories, design patterns, storyboards and Compendium LD diagrams), the application of IBL and TEL design principles, roles, discussion and negotiation, phases, conflicts and key issues.*

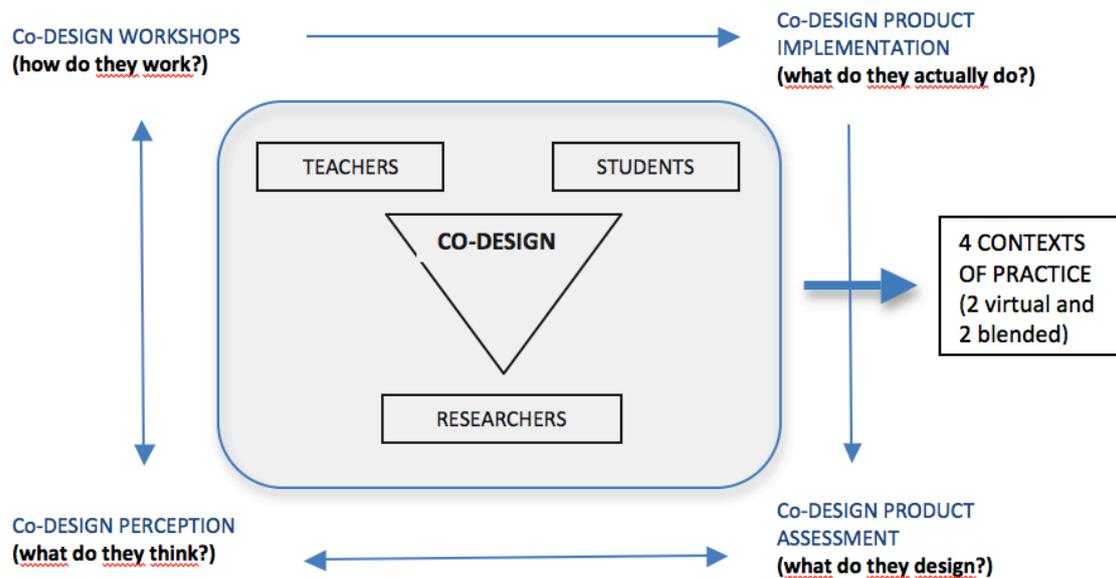


Figure 1: Co-design process analysis framework

These dimensions are discussed from four perspectives or different viewpoints that reinforce each other, as shown in Figure 1. It is a holistic model of analysis of the co-design process, which in turn allows the triangulation of data and methods, in order to preserve the research trustworthiness. For the purposes of this study, we are interested specifically in two of them: a) How participants work in co-design workshops. b) How participants perceive co-design and how their thoughts and expectations evolve along this process. For the analysis of qualitative data (interviews, observations, field notes and post-session questionnaire) the constant comparative method of Glasser and Strauss (1967) will be used, while for the quantifiable data collected with the post-session questionnaire a descriptive statistical analysis will be performed.

Conclusion

This paper presents the first phase of an investigation based on the co-design process of inquiry-based and technology-enhanced learning scenarios in two different universities. The co-design approach integrates components from the field of participatory design and the domain of learning design. From this perspective, and in accordance with the research background, the effectiveness of certain learning design instruments to represent teaching and learning practice and their usefulness for scaffolding co-design processes are put into question. For this reason, the study focuses on the analysis of facilitating or hindering factors in the co-design process, with special emphasis on: a) the participatory and collaborative dynamics and b) the mediating action played by the design instruments used to represent practice. To this end we propose a research design and a framework of

analysis that allow capturing the experience of co-designing inquiry-based and technology-enhanced learning scenarios from a holistic perspective.

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Acknowledgements: the Design2Learn project is funded within the R+D National Plan, by the Ministry of Economy and Competitiveness of Spain. We also would like to thank the six professors participating in the research for their involvement and collaboration.

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