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TESIS DOCTORAL

Identificación de factores que afectan a la adopción de métodos y herramientas de Diseño de Aprendizaje, y soluciones para fomentarla

Presentada por Francesca Maria Dagnino
para optar al grado de
Doctor/a por la Universidad de Valladolid

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Universidad de Valladolid

DOCTORAL PROGRAM IN
TRANSDISCIPLINAR RESEARCH IN
EDUCATION

DOCTORAL THESIS

Identifying factors affecting the adoption of Learning Design methods and tools, and solutions to encourage it

Presented by Francesca Maria Dagnino
to qualify for the degree of
Doctor for the University of Valladolid

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Ioannis Dimitriadis Damoulis
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Acknowledgements

When I enrolled in the doctoral programme, some years ago, I knew that it would have been a highly formative experience from the professional and personal point of view, but I knew also that it would have been demanding and hard… and it was. Now that it is finally coming to an end, I want to thank all the people who have accompanied me on this long journey.

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Genova, October 2023

Abstract

In the knowledge society teachers are dealing with new scenarios for teaching and learning. Learning may happen in different contexts, from formal education (school, university) to non-formal and informal learning situations. In this context of increasing complexity, in which digital technologies may enhance the learning experience, teachers are called to become designers for learning in order to fruitfully integrate them in the teaching and learning process.
Researchers in the field of Technology Enhanced Learning have devoted their attention to supporting teachers in this complex process of developing and devising educational interventions supported by technological tools and reflecting on them, this research area is called Learning Design. This effort resulted in the development of frameworks, methods and tools which allow teachers to produce artefacts (designs) able to support teachers in the process of designing for learning.
Nevertheless, the impact of these research results seems to remain limited on the actual teaching practice and this is still a gap in the field.
This thesis work aims to understand how the adoption of Learning Design methods and tools can be supported. To pursue this goal, two research objectives were identified; the first was to understand the factors behind the limited adoption of Learning Design methods and tools by teachers, the second was to identify actions/solutions to be taken to support the adoption of Learning Design methods and tools. Given the complexity of the phenomenon studied, an articulated research design was conceived grounding on a mixed methods research approach. The design included a systematic literature review, a Delphi study, and a case study.
To reach the first objective, data were firstly collected through the systematic literature review that allowed me to identify categories of factors affecting adoption: teachers' needs for methods and tools for Learning Design and barriers to adoption. Afterwards, these categories of factors were deepened through the Delphi study, in which experts were asked to rank the categories of factors and rate the importance of the single factors. Moreover, experts were required to propose further needs and barriers to be included. Then, the same factors were studied in the context of a case study carried out in a secondary school and involving practising teachers. The result of this complex process was a list of teacher's needs and barriers affecting the adoption of Learning Design methods and tools. While the identified needs are often related to the characteristics of the specific methods and tools (such as flexibility, easiness of use or coherence with the teacher's design thinking), most of the barriers are 'tool-independent' and are often related to the context where teachers operate (such as the support of the institution, or the

issue of time/workload). Barriers resulted to be less explored in existing research studies and to deserve more attention.
The second objective, namely the identification and testing of possible actions/solutions to support adoption, was pursued in the context of the Delphi study and - again - within the case study. In the Delphi study experts were invited to propose solutions tackling the needs and barriers discussed. The case study was designed as a sequence of two iterations, following the Design-Based research approach. In the first iteration, a set of solutions were conceived to address some of the needs and barriers resulting from the systematic literature review and were then tested. In the second iteration other needs and barriers were addressed, which derived from the systematic review and were considered relevant after the first iteration. Specific solutions were implemented following the suggestions of the experts collected through the Delphi study.
The proposed solutions, addressing method and tool-related issues, as well as the 'tool-independent' ones, failed to support adoption in the context of the study. This outcome allowed me to reflect on the role of those factors more related to context and individuals. These factors should be addressed, especially when adoption is pursued at the institutional level.
The results of this thesis are suggestive of future research goals with regard to both the specific approach taken (the analysis of needs and barriers) and more generally for the field of Learning Design. Research on adoption should gain relevance in the field and teachers' needs and barriers to adoption might become targets of this research.

Keywords:
Learning Design, Technology Enhanced Learning, Teacher as Designer, Mixed Methods, Systematic Literature Review, Delphi Study, Case Study.

Resumen

En la sociedad del conocimiento, los profesores se enfrentan a nuevos escenarios de enseñanza y aprendizaje donde la tecnología está cada vez más presente. El aprendizaje puede tener lugar en diferentes contextos, desde la educación formal (escuela, universidad) hasta situaciones de aprendizaje no formal e informal. En este contexto de creciente complejidad, en el que las tecnologías digitales pueden mejorar la experiencia educativa, los profesores están llamados a convertirse en diseñadores del aprendizaje para integrarlas fructíferamente en la educación.

Los investigadores en el campo del Aprendizaje Apoyado por Tecnología (Technology Enhanced Learning, TEL) han dedicado su atención a ayudar a los profesores en este complejo proceso de desarrollar e idear intervenciones educativas apoyadas en herramientas tecnológicas y reflexionar sobre ellas. Este área de investigación, denominado Diseño del Aprendizaje (Learning Design, LD), se ha traducido en el desarrollo de marcos, métodos y herramientas capaces de apoyar al profesorado en sus procesos de diseño educativo. Sin embargo, el impacto de los resultados de estas investigaciones parece seguir siendo limitado en la práctica educativa real, y esto supone una laguna importante en el campo.

Este trabajo de tesis pretende comprender cómo se puede apoyar la adopción de métodos y herramientas de Diseño del Aprendizaje. Para lograrlo, se identificaron dos objetivos de investigación: el primero, comprender los factores que limitan la adopción de métodos y herramientas de Diseño del Aprendizaje por parte del profesorado; el segunda, identificar las acciones/soluciones que deben tomarse para apoyar la adopción de métodos y herramientas de Diseño del Aprendizaje. Dada la complejidad del fenómeno estudiado, se elaboró un diseño de investigación basado en un enfoque de métodos mixtos y que engloba una revisión sistemática de la literatura, un estudio Delphi y un estudio de casos.

Para conseguir el primer objetivo, se comenzó con la recolección de datos a través de la revisión sistemática de la literatura, que permitió identificar categorías de factores que afectan a la adopción: las necesidades de los profesores en cuanto a métodos y herramientas para el Diseño del Aprendizaje y las barreras en la adopción. Posteriormente, se profundizó en estos factores que se convirtieron en mis categorías para el estudio Delphi, en el que se pidió a los expertos que clasificaran las categorías de factores y valoraran la importancia de cada una de ellas. Además, se pidió a los expertos que propusieran otras necesidades y barreras que debían incluirse en esta estructura de análisis. A continuación, se estudiaron los mismos factores en el contexto de un estudio de caso realizado en un centro de enseñanza secundaria y en el que participó parte del profesorado del centro. El resultado de este complejo proceso fue una lista de necesidades y barreras del profesorado que afectan a la adopción de métodos y herramientas de

Diseño del Aprendizaje. Mientras que las necesidades identificadas suelen estar relacionadas con las características de los métodos y herramientas específicos (como la flexibilidad, la facilidad de uso o la coherencia con el pensamiento de diseño del profesor), la mayoría de los obstáculos son "independientes de la herramienta" y suelen estar relacionados con el contexto en el que trabaja el profesorado (como el apoyo de la institución o la cuestión del tiempo/carga de trabajo). Las barreras resultaron estar menos exploradas en los estudios de investigación existentes y han merecido mi trabajo y atención.
El segundo objetivo, la identificación y comprobación de posibles acciones/soluciones para apoyar la adopción, se analizó en el contexto del estudio Delphi y, de nuevo, dentro del estudio de casos. En el estudio Delphi se invitó a los expertos a proponer soluciones que abordaran las necesidades y barreras debatidas. El estudio de caso se diseñó como una secuencia de dos iteraciones, siguiendo el enfoque de "investigación basada en el diseño" (Design Based Research, DBR). En la primera iteración se elaboró un conjunto de soluciones para abordar algunas de las necesidades y barreras resultantes de la revisión sistemática de la literatura y, a continuación, se pusieron a prueba. En la segunda iteración se abordaron otras necesidades y barreras derivadas de la revisión sistemática, que se consideraron pertinentes tras la primera iteración. Y terminé aplicando soluciones específicas siguiendo las sugerencias de los expertos recogidas a través del estudio Delphi.
Las soluciones propuestas, que abordaban cuestiones relacionadas con el método y la herramienta, así como las "independientes de la herramienta", no lograron apoyar la adopción en el contexto del estudio, pero el resultado permitió reflexionar sobre el papel de los factores más relacionados con el contexto y los individuos. Estos factores deberían tenerse en cuenta, especialmente cuando la adopción se persigue a nivel institucional.
Los resultados de esta tesis son sugerentes para futuros objetivos de investigación, tanto en lo que respecta al enfoque específico adoptado (el análisis de necesidades y barreras) como, de forma más general, para el campo del Diseño del Aprendizaje. La investigación sobre la adopción debería ganar relevancia en este campo y las necesidades de los profesores y las barreras a la adopción podrían convertirse en objetivos de esta investigación futura.

Palabras clave:
Diseño del Aprendizaje, Aprendizaje potenciado por la tecnología, Profesor como diseñador, Métodos mixtos, Revisión sistemática de la literatura, Estudio Delphi, Estudio de casos.

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Chapter 1
Introduction

This chapter introduces the thesis work and provides a summary of the whole thesis. In particular, it deals with the theoretical context in which the thesis was framed, the main goals and objectives addressed, the methodology adopted to carry out the research, and the main contributions that the thesis work intended to bring in the field. The thesis work deals with the adoption of Learning Design (LD) methods and tools, which although considered a critical issue in the Technology Enhanced Learning research field is still scarcely investigated. This research tackles the Learning Design uptake by exploring the factors affecting adoption and the possible actions/solutions that can be taken to foster it. The work grounds on a mixed-methods approach that ensured the involvement of different actors (researchers and teachers) and the collection and analysis of different kinds of data (qualitative and quantitative) from different sources. The contributions brought in the field are the identification of both the factors and the possible actions to be taken to foster the adoption of Learning Design methods and tools.

1.1 Introduction

In the current knowledge society, education faces the challenge of dealing with the new complex nature of knowledge, which is now dynamic and distributed.

Teachers are confronted with a technology-rich, evolving and demanding context which calls for a re-definition of the role of educators that is not any more to "provide knowledge", but to guide the learning process by creating the conditions for learners to learn and construct or co-construct their knowledge, while exploiting the technologies available (Mor, Craft, & Maina, 2015; Olimpo, 2010). Therefore, teachers are required to become "designers for learning" (Goodyear & Dimitriadis, 2013); the process of designing learning entails defining a number of variables, including tasks, physical and digital environments, forms of social or-

ganisation (groups, communities, etc.) and distribution of work (Goodyear, 2015).

In the field of Technology Enhanced Learning specific attention has been paid to the role of teachers as designers, with the aim of supporting them in the process of devising and describing their educational interventions so that they can take thorough pedagogical decisions and make a fruitful use of technologies (Goodyear, 2015; Laurillard, 2012). Moreover, researchers have been aiming to support teachers in reflecting on their practice and to foster the designs' sharing, adaptation and reusing (Laurillard et al., 2013). Research carried out on Learning Design aims, indeed, to reach these goals. According to Dalziel et al. (2016) the field of Learning Design "*seeks to develop a descriptive framework for teaching and learning activities ("educational notation"), and to explore how this framework can assist educators to share and adopt great teaching ideas"* (p. 4).

The Learning Design field grounds on a sociocultural perspective (Conole, 2016), and conceives design as an activity mediated by artefacts apt to guide the design process and make decisions explicit, shareable, and reusable in the context of communities of designers (Mor, Craft, & Hernández-Leo, 2013). Research in Learning Design explored several aspects of the design process, in terms, for example, of forms of representations (Conole, 2010), methods aimed at guiding the process of designing in a structured way and tools that can support environments for the design process (Conole, 2013).

Despite the considerable research efforts, according to several authors (see, e.g., Asensio-Pérez, Dimitriadis, Prieto, Hernández-Leo, & Mor, 2014; Bennett, Agostinho & Lockyer, 2017; Hernández-Leo, et al., 2018) the impact on teachers' practice seems to remain limited.

The lack of adoption of Learning Design methods and tools has rarely been studied as the primary problem before this thesis work. The issue was investigated by researchers in the field but mainly in the context of studies about specific methods and tools (see for example Neumann et al., (2010), who explored the problems in adopting the specifications of IMS-LD).

An attempt to analyse the problem of adoption was made by Celik and Magoulas (2016b), who, in a systematic review of the literature, approached it from the perspective of teachers' needs and their perceptions of existing tools; the study had an interesting approach that will also be considered in this thesis work (the analysis of teachers' needs), but it leaved out the aspect of barriers to adoption.

As far as barriers, Asensio-Pérez and colleagues (2017) tried to summarise the findings of different researchers, identifying three areas in which they may reside:

1. **Characteristics of Learning Design tools:** e.g., the lack of capability of the tool to be flexible enough to allow the integration of different solutions, or to support all the phases of the design process, or to provide support to the community of designers (Bennett, Agostinho, & Lockyer,

2015; Hernández-Leo, Chacón, Prieto, Asensio-Pérez, & Derntl, 2013; Voogt et al., 2011).

2. **Teachers' mindset:** the lack of a mindset oriented to Learning Design can represent a barrier and its change was considered a necessary premise favouring the design of the learning activities (Dimitriadis & Goodyear, 2013).
3. **Adequate training:** the lack of adequate training might hinder Learning Design adoption. For this reason, Maina, Craft, & Mor (2015) highlight the importance of professional development to promote the uptake of Learning Design tools and practices.

The above-mentioned works can be taken as starting points, but they couldn't be considered as exhaustive in the analysis of the problem; therefore, this issue is still a gap in the field. As it will be described in the following sections, this research work has the aim of filling this gap in.

1.2 Objectives

The main goal of this thesis is identifying how the adoption of Learning Design methods and tools can be encouraged.

To pursue the main goal, it is necessary to understand what factors would affect adoption and then identify actions/solutions that act on these factors so that adoption may be fostered.

Therefore, I identified the following two objectives:

1. **Understand the factors behind the limited adoption of Learning Design methods and tools by teachers**.

Despite the focus put by several researchers on the limited adoption of Learning Design methods and tools, a few studies have been specifically dedicated to understanding what factors might influence adoption (Celik & Magoulas, 2016b). Studies tend to focus on the experiences of teachers with specific tools (see for example, Conole 2014; Hernández-Leo, Moreno, Carrió, Chacón, & Blat, 2015; Katsamani & Retalis, 2013) instead of taking a wider perspective (i.e., analyse the adoption of different tools) and considering more transversal factors, namely factors that may prevent Learning Design uptake in general. In this thesis work I decided to tackle the issue from a double point of view, starting from the premise that the lack of capability of the methods and tools to address the teachers' needs can hinder the adoption and represent a barrier itself. Therefore, I decided to investigate the teachers' needs that methods and tools should address, as well as the possible limits (i.e., barriers) that teachers may encounter using the proposed Learning Design methods and tools. This objective is linked with the research question 1 (RQ1): *What are the factors affecting the adoption of Learning Design*

methods and tools?.

2. **Identify actions/solutions to be taken to support the adoption of Learning Design methods and tools**.

In these years plenty of methods and tools for Learning Design have been developed (Celik & Magoulas, 2016a), with the goal of supporting teachers in the design process; the development of new tools was often driven by the will to test the proposals of different research groups working in the field, with a limited view on the factors behind the adoption of Learning Design methods and tools in general. This approach may have affected the effectiveness of solutions proposed through the years to support the adoption. Therefore, after having identified teachers' specific needs and barriers, this thesis work aims to identify possible solutions addressing such needs and barriers and test these solutions in order to assess their effectiveness in a real context. This objective is linked with the RQ2: *What actions/solutions can support the adoption of Learning Design methods and tools?*.

Figure 1.1 represents the context, main goal, objectives and research questions of the thesis.

1.3 Research methodology

In conducting research, it is essential to first establish the research approach, which will guide the following choices in terms of methods. According to Creswell (2014) and Creswell and Creswell (2018), the research approach is informed by researchers' a-priori philosophy and their worldview, but for sure researchers should also consider the phenomenon they intend to study and therefore, in my view, they need to be flexible enough and eventually not to stick with one single worldview.

Creswell (2014) identifies four worldviews that are widely discussed in the literature: post-positivist, constructivist, transformative and pragmatic.

My personal worldview is close to the constructivist paradigm, interpretative and aimed at approaching the phenomenon subject of study by understanding the viewpoints of all the people involved.

At the same time, I acknowledge the phenomenon subject of this thesis stands as a problem (the lack of adoption of Learning Design methods and tools) and requires it to be studied in the environment in which it shows itself, i.e., the educational institutions. Therefore, the pragmatic approach is probably more suitable to approach the issue addressed in the thesis.

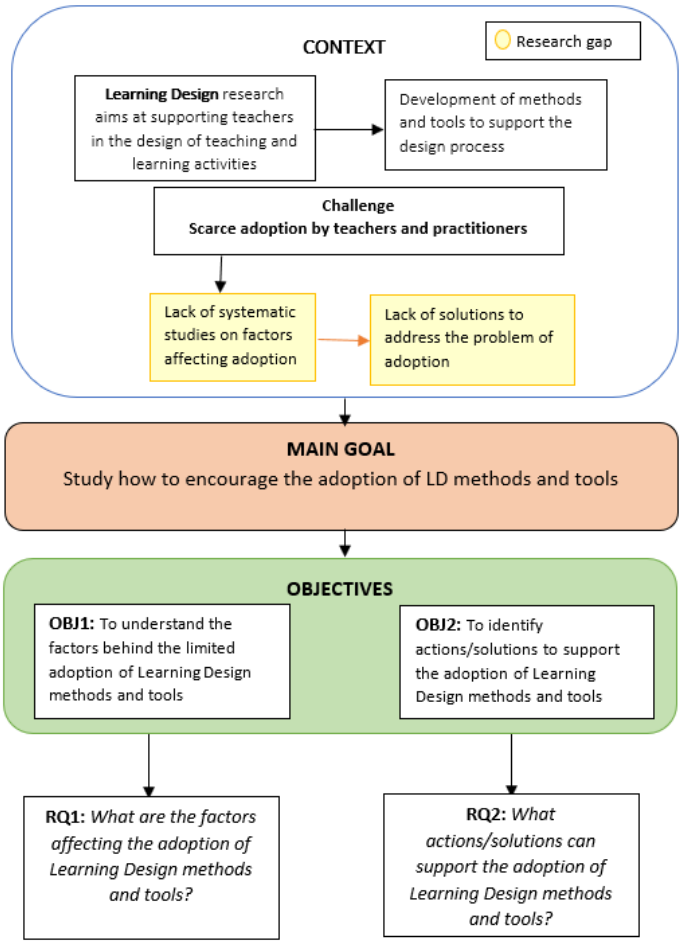

Figure 1.1 - Context, main goal, objectives and research questions of the thesis

As Creswell underlines (2014), the pragmatic approach puts the focus on the research problem and the aim of the research is not (dis)confirming a theory or developing a new theory from data, but rather proposing solutions to a problem. As far as the methods to be adopted in the study, the pragmatic approach leaves the researcher free to choose the methods and procedures that best match the specific needs and purpose, but it is considered the philosophical underpinning for mixed methods studies. Given this consideration and in the light of the complexi-

ty of the problem and the plural sources of data, I identified mixed methods as a suitable approach for the research.

Mixed method research is an approach that combines both qualitative and quantitative data collection and analysis techniques (Creswell & Plano Clark, 2007). The strength of this complex approach consists of multiple data collection and analysis methods, aiming to increase the reliability of findings and conclusions reached, thanks to the possibility to complement and triangulate data.

In this specific context, there are at least two categories of stakeholders that are interested in the development and use of Learning Design methods and tools, who should be involved in the research: researchers and teachers.

The type of data that can potentially be collected in order to frame and understand the phenomenon is also diverse:

- The already existing literature that is the necessary premise on which to build upon.
- Data about the use of Learning Design tools from the field that could represent a useful source for exploring the issue and the point of view of teachers.
- Experts' opinions that could also complement the findings in terms of validation of the approach and impact on future research.

The design of the whole research derives from the 'explanatory sequential' design (Creswell, 2014) and envisages a 'quantitative-qualitative-interpretation' sequence. In the case of this research, the methods were innerly mixed, since qualitative/quantitative data collection and analysis methods are integrated in each phase of the research:

- In the first phase a systematic literature review (Petticrew, 2001) was carried out. Systematic literature reviews have the aim to identify, analyse and synthesise the existing literature to answer a specific research question (Petticrew, 2001). This approach was identified with the aim to answer the first RQ: *What are the factors affecting the adoption of Learning Design methods and tools?*. The systematic literature review was mainly quantitative but also contained qualitative aspects.
- The second phase foresaw two research methods carried out in parallel: a Delphi study (Dalkey & Helmer, 1963) and a case study (Stake, 1995). The Delphi study method is a group technique aimed at reaching reliable consensus among experts about a specific topic (Dalkey & Helmer, 1963). The Delphi study was used in this thesis work to collect the opinions of experts in the Learning Design field regarding the relative importance of the categories of factors investigated in the thesis (i.e., teachers' needs and barriers), in the adoption of Learning Design methods and tools (RQ1). Experts were also asked to suggest solutions to support the

adoption (RQ2). Moreover, in the thesis work an instrumental case study was carried out (Stake, 2005). This type of case study is not oriented to study a specific case, but it supports the understanding of a phenomenon, that was indeed my aim. The case study provided an ecological context in which it was possible to study the factors affecting adoption (RQ1) and to test possible solutions to support it (RQ2). The two methods were mainly qualitative but included quantitative elements as well.

Figure 1.2 describes the design of the thesis work

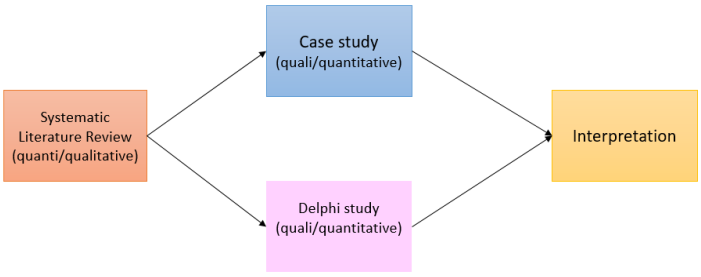

Figure 1.2 - Design of the thesis work

1.4 Contributions

This section describes the main intended contributions of the thesis to the field of Learning Design. Figure 1.3 is an extended version of the diagram shown in Figure 1.1: besides thesis context and objectives, it shows the contributions and evaluation.

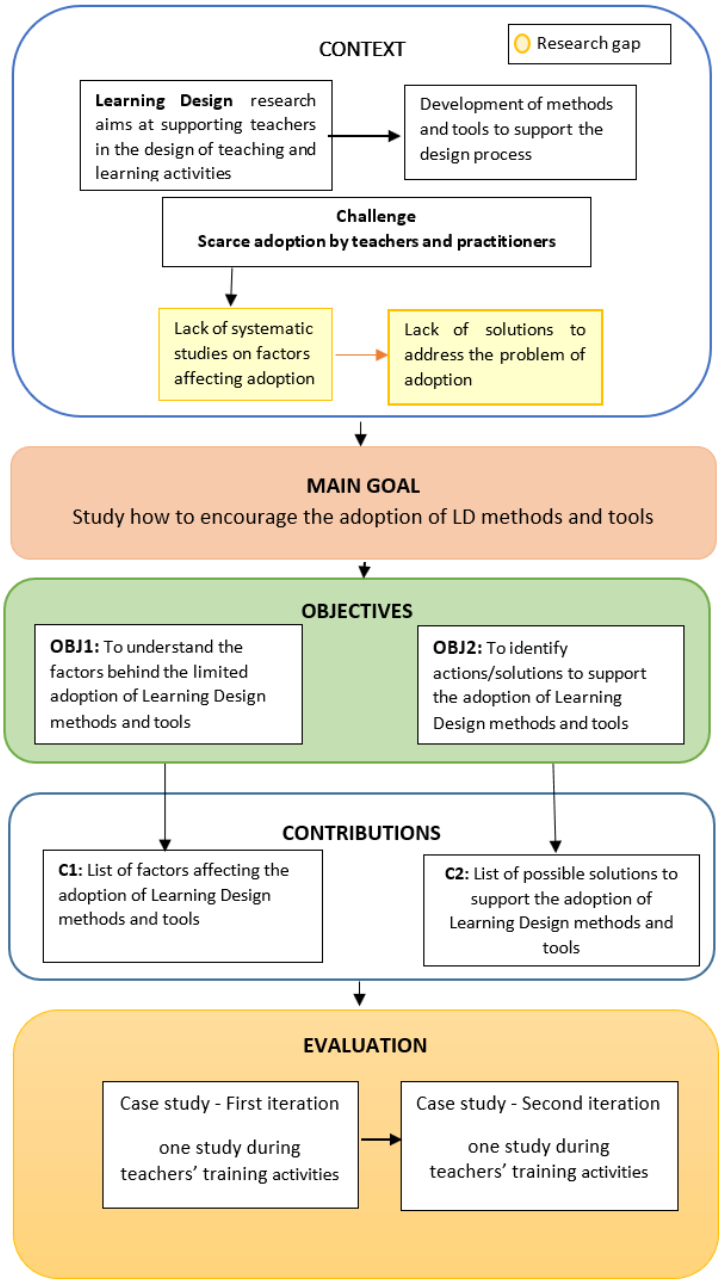

Figure 1.3 - General overview of the context, goal, objectives, contributions and evaluation of the thesis

The main contributions are:

1. List of factors (needs and barriers) affecting the adoption of Learning Design methods and tools.
2. List of possible solutions to support adoption of Learning Design methods and tools.

These contributions are presented in more detail below:

1. **List of factors (needs and barriers) affecting the adoption of Learning Design methods and tools:** this first contribution derives from the literature review, the Delphi study and the in-field data collection of the case study. This first contribution addresses RQ1. I approached the existing literature on Learning Design to analyse two categories of factors: what teachers consider desirable in a Learning Design method or tool (i.e., needs) and the obstacles teachers encounter to the adoption of Learning Design methods and tools in their teaching practice (i.e., barriers). Even though the limited adoption is a declared issue in the field, to the best of my knowledge this kind of approach wasn't taken before and, in general, studies rarely address these two aspects directly. For this reason, in this thesis needs and barriers were mainly inferred in studies conducted for other aims (e.g., the evaluation of Learning Design tools). In the analysis, needs were not organised, while barriers to tools' adoption were organised following the categorization proposed by Ertmer (1999), who introduced two orders of barriers to technology integration: first order barriers are defined as extrinsic to teachers and are represented by the "*types of resources (e.g., equipment, time, training, support) that are either missing or inadequately provided in teachers' implementation environments"* (p. 50); second order barriers, on the contrary, are intrinsic individual barriers, deeply ingrained and therefore not so easy to overcome.
   The aim of the Delphi study was to go one step further with respect to the above-mentioned literature review, by identifying the relative importance of the different critical factors for Learning Design adoption and also collect further needs or barriers that did not result from the literature.
2. **List of possible solutions to support the adoption of Learning Design methods and tools:** solutions were conceived according to the results of the systematic literature review, the Delphi study and the analysis of the specific context in which the case study was carried out.
   The proposed solutions tackled both the teachers' needs and the barriers and were related to methods and tools, as well as to transversal and contextual factors that were identified through the systematic literature review. Solutions were tested in the context of the case study. Being a spe-

cific context, the results have been analysed and discussed in the light of the context itself, the transferability of the results has been supported resorting to the thick description (Lincoln & Guba, 1985) of the case study.

1.5 Structure of the rest of the document

The thesis is organised as follows:

In chapter 2 the theoretical background of the thesis is presented. Looking at the transformations that have affected education in the last decades, I outline the origins and development of the research field of Learning Design in the broader context of Technology Enhanced Learning. I briefly explore the landscape of methods and tools developed over the years and the challenges faced by researchers in the field regarding them. Finally, I introduce the issue of their adoption, which is the focus of this thesis work.

Chapter 3 is focused on the methodology of the thesis. Firstly, I describe the research approach taken, motivated by the nature of the phenomenon under study. Afterwards, I present and discuss the methods adopted and the design of the whole research. Besides the overall design, in chapter 3 I also describe each single method used in the research (systematic literature review, Delphi study and case study) from a theoretical point of view, while how the methods have been applied in the thesis and the procedures of data collection and analysis are described separately in chapters 4, 5 and 6.

Chapters 4, 5 and 6 are focused on the different research methods adopted.

In particular, chapter 4 describes the systematic literature review that was carried out in the first phase of the thesis work and its update. The systematic review approaches the adoption of Learning Design methods and tools exploring categories of factors that may affect it (teachers' needs for Learning Design methods and tools and barriers to adoption) and discuss their impact. At the end of the chapter, I report the update of the original review, conducted to analyse the advancements in the field.

In chapter 5, I describe the Delphi study carried out involving experts in the field of Learning Design. The Delphi study was aimed at deepening the analysis of the factors affecting adoption and at collecting suggestions about possible solutions to support adoption. In the chapter I describe the rationale behind the adoption of this specific method to collect experts' opinion, the set-up of the Delphi study and its results, which are discussed at the end of the chapter.

Chapter 6 reports the design and carrying out of the case study. Results are discussed at the end of the chapter. In chapter 7, data collected in the different phases of the research are triangulated and discussed to complement the findings from the different methods. In the second part of the chapter, conclusions are

drawn, considering the limitations of the study too. Finally future work directions are proposed.
Appendices of the dissertation include: the data collection tools used in the context of the case study (Appendix 1. Data collection tools) and the detailed results (Appendix 2. Results).

Chapter 2
Theoretical background

This chapter explores the origin and development of the research field of Learning Design in the broader context of Technology Enhanced Learning. It starts introducing the concept of teachers as learning designers, that was proposed in the light of the challenges that teachers need to face currently in their work. Designing for learning has become essential to address the new needs of the learners and this highly impacts the professional development of teachers.

Afterward, the field of Learning Design and its theoretical foundations are presented (Dalziel et al., 2016), considering its main contact points and differences with Instructional Design. In the following sections, an overview of the evolution of tools and methods over time is provided, and some comparative studies are analysed that lead to the identification of several open issues in the field. Based on such analysis, the main theme of this thesis emerges, i.e., the lack of adoption of Learning Design methods and tools, which is further studied in chapter 4.

2.1 Teachers as learning designers

In the last decade, designing for learning has become a central concept in the Technology Enhanced Learning field. Due to the widespread use of technologies and the need to integrate them in teaching and learning activities, teachers need to take sound pedagogical and technological decisions to teach effectively.

In this line, some authors introduced the concepts of 'designing for learning' or 'teachers as designers' (Goodyear & Dimitriadis, 2013; Goodyear, 2015; Kalantzis & Cope, 2010; Kali, McKenney, & Sagy 2015; Laurillard, 2012). These definitions do not suggest that learning can be designed, but that "*someone involved in the design for learning can design things that help other people learn"* (Goodyear & Dimitriadis, 2013, p.2). According to Goodyear (2015), teaching as

design implies devoting more time to what he calls the pre-active form of teaching (planning) and this should be the intelligent centre of the whole teaching-learning lifecycle.

Goodyear (2015) states that there are three main classes of things which can be designed: (i) the learning tasks, (ii) the physical and digital environments, and (iii) the social organisation and the sharing of labour. Each of these classes needs to be conceived, designed, and managed at multiple levels by different subjects. Goodyear and Dimitriadis (2013) state that the focus of the design should be the (i) tasks, since their nature affects the success of the learning process, as outcomes are dependent on the task. Frequently, designs for learning should find the way to balance multiple learning goals and expected outcomes. With respect to the (ii) learning environments, it is worth noting that nowadays teachers deal with environments that are far more complex than in the past; the traditional classroom that used to be physically located in one place is now distributed and technologies are integral parts of these environments. Finally, as learning is socially situated, designs should also consider the (iii) social architecture for learning, for example if and how students are expected to work in pairs or in larger groups.

This is exactly the aim of Learning Design research: to help and guide teachers in designing their teaching interventions so that they are pedagogically informed and make an effective use of resources and technologies (Conole, 2013).

In the next sections (2.2 and 2.3) the origins and theoretical foundations of Learning Design and its relationship with the field of Instructional Design are presented.

2.2 Learning Design origins

The field of Learning Design has gained momentum in the last decades, but it can be considered as stemming from the prior research area of Instructional Design. Instructional Design is defined as "*a systematic process that is employed to develop education and training programs in a consistent and reliable fashion"* (Reiser & Dempsey, 2007 p. XX). Instructional Design is historically and traditionally rooted in cognitive and behavioural psychology. It was born in the years of Second World War with the need for training of military forces in the USA, that led to the massive development of training programs based on audiovisual resources (Dick, 1987). As Persico and Pozzi (2015) pointed out, the field of Instructional Design has evolved in line with learning theories and advances in technologies, but some constants can be found in the different models of educational systems development (Gustafson & Branch, 2002; Persico, 1997). In most models the first step consists in the analysis of the learners' needs and context requirements, followed by the definition of specifications, the identification of

approaches and tools, the development or identification of resources and evaluation tools, and finally the delivery, with the implementation of instruction processing and data collection for evaluation. These steps characterize one of the most popular Instructional Design models: the ADDIE model (Analysis, Design, Development, Implementation and Evaluation) (Molenda, Pershing, & Reigelhut, 1996).

Instructional Design has been and is still very helpful to design large-scale online educational programs, while it does not seem to fit with the needs of single teachers in the daily design routine (Persico & Pozzi, 2015).

The field of Learning Design whose origin is mostly found in the European context, shares with Instructional Design the focus on the design process, nevertheless it stresses the centrality of the learner and seems to be more oriented toward teachers aiming to help them in developing and sharing their own ideas and practices. Wasson and Kirschner (2020) consider Learning Design as the expression of a different mindset where the emphasis is on the goal (i.e., learning) rather than the approach (i.e., instruction).

As Dalziel et al. (2016) highlight, this field has been seeking "*to develop a descriptive framework for teaching and learning activities ("educational notation") and to explore how this framework can assist educators to share and adopt great teaching ideas*" (p.6). The idea of notation was taken from the field of music, where the standard notation allows musicians to share ideas across time and places.

This concept of descriptive framework can be applied both to online and face-to-face education that are supported by educational technologies. One major goal of the field focused on the development of Educational Modelling Languages (EML) (Giesbers et al., 2007) that allow for a computational interpretation of the learning designs conceptualized and authored by educational designers. A prominent example of EML refers to the one proposed by Koper and colleagues at the Open University (OU) of the Netherlands (Koper, 2001) that was then used as the basis for the IMS-LD specification in 2003 (IMS GLC, 2003). According to (Dalziel et al., 2016) Learning Design was also greatly influenced by:

- A corpus of research on technology in higher education in the UK, including the SoURCE project (e.g., Laurillard & McAndrew, 2002) and the studies of Diana Laurillard, Grainne Conole, Helen Beetham and others.
- The Australian Universities Teaching Council (AUTC) Learning Design project based at Wollongong University, carried out by Ron Oliver, Barry Harper, John Hedberg and Sandra Wills (this project had explicit links to the SoURCE project).
- The "Learning Activity Management System" (LAMS) project carried out by James Dalziel at Macquarie University, Australia (Dalziel, 2003).

As said above the common ground of these projects was the attempt to develop and implement descriptive frameworks, that in the cases of OU-EML and LAMS, resulted in a technical language for describing and sharing sequences of technology-supported learning activities (IMS-LD and LAMS-LD respectively) and in the development of software systems for authoring and implementation of activities (ReLoad/CopperCore/SLeD and LAMS). The SoURCE and AUTC Learning Design projects both developed examples of software systems and focused on describing and sharing pedagogically effective sequences of activities.

A lot of research originated from these core studies in the last decades, aiming not just at identifying technological solutions but also to support educators in adopting new teaching methods.

2.3 Theoretical foundations of Learning Design

As far as the similarities and differences between Instructional Design and Learning Design, Conole (2016) discussed the theoretical underpinnings of Learning Design, identifying the socio-cultural and ecological perspectives as the references for it.

Instructional Design is grounded on cognitive theories that conceived knowledge as something that can be acquired at the individual level and, therefore, instruction should be oriented to facilitate this process of acquisition. On the contrary, Learning Design relies on a sociocultural perspective that, as highlighted by Barab, Evans and Baek (2003), conceives cognition and meaning creation as a highly social and contextual process. Sfard (1998) (as cited in Barab et al., 2003) described this transition in cognitive science and educational theories as a shift from the metaphor of 'acquisition' towards a metaphor of 'participation', in which knowledge, reconceptualized as 'knowing about', is regarded as an activity that is situated. The sociocultural perspective provides guidelines for the design of constructivist learning environments, drawn from Vygotsky's (1978) notions (Barab et al., 2003): (1) the instructor has the role of facilitator to help students in actively participate in the learning process; (2) instructional materials should be structured to support student collaboration; (3) instruction should be designed to reach a developmental level just above the current level of the students; (4) to provide a learning context meaningful for the students the design should use a wide variety of tools, such as raw materials and interactive technology (e.g., computers); (5) student evaluations should focus on the students' understanding, based on application and performance.

In this theoretical framework, Conole (2016) retrieves the concept of mediating artefact, introduced by Vygotsky (1962[1], 1978), who conceived it as the tool mediating the relationship between the object of cognition and the active subject, in a triadic relationship. These tools or instruments can be both material or psychological (such as signs and symbols) since Vygotsky considers social interactions as playing a role in cognitive development and assimilates speech and words (signs) to tools. According to this vision, humans use speaking and writing to mediate their social environment, and these, as the other tools, are firstly shared among individuals at a social level and only afterward they can be internalized. Everything that results in the creation of something (also a shared meaning) is mediated in some way: in a discussion, the mediating artefacts are words and language used to communicate, in learning the mediating artefacts are the resources used, and again the language.

Conole (2016), indeed, refers to the concept of mediating artefacts in relation to Learning Design, in terms of what it is used to guide the design process. According to her "*Learning Design research is interested in establishing what Learning Design mediating artifacts practitioners use and what new ones can be created to help guide the design process"* (p.45). The process is focused on learning activities that can be represented in several ways, that are all useful in different contexts and have a different level of abstraction/detail.

The second perspective that Conole (2016) considers underpinned by Learning Design is the ecological perspective, in which emphasis is put on designing in an environment that is dynamic, where both designers and design should change and adapt. Again, Conole refers to a core concept in the ecological perspective - the concept of affordance - and applies it to the context of Learning Design. Affordances of an environment are defined by Gibson as "*what it offers the animal, what it provides or furnishes, either for good or ill"* (Gibson, 1979, p. 127); Affordances are characteristics of the environment that suggest specific actions in relation to the user (Gibson, 1979). Conole and Dyke (2004) state that also digital technologies have affordances and identify ten affordances associated with them: 1) accessibility, 2) speed of change, 3) diversity, 4) communication and collaboration, 5) reflection, 6) multimodal and non-linear, 7) risk, fragility and uncertainty, 8) immediacy, 9) monopolization and 10) surveillance. The two authors pointed out that this taxonomy has several uses, e.g., guiding the use of technologies for achieving specific goals, helping to identify potential limitations and the inappropriate use of technologies, or to understand the advantages or disadvantages of different technologies. Conole (2016) highlights that the application of the concept of affordance (as far as debated) seems to be useful because it highlights the

[1] The book 'Thought and Language' was originally published in 1934.

relationship between technologies and individuals and this interplay influences the way in which design is carried out.

In section 2.4 Learning Design methods and tools development through years is explored; based on the conceptualizations and theoretical frameworks of section 2.3, the following section maps methods and tools, and it comparatively assesses them. Finally, the problem of adoption of the proposed Learning Design methods and tools is described, showing the existence and relevance of this research gap.

2.4 Learning Design methods and tools

2.4.1 Mapping Learning Design methods and tools

The development of methods and tools for supporting the design process has been one of the main research lines in the field. Over the years a considerable number of methods and tools have been proposed, supporting different types of representation of the design (e.g., visual, textual) or pedagogical approaches underpinned, if any (e.g., collaborative learning). As pointed out by Persico et al. (2013), this variety has also made it difficult for researchers in the field to know what tools are available and to identify among them those that might be most suitable for different purposes.

Attempts have been made to map and organize the available tools and related methods. For example, the work of Celik and Magoulas (2016a) tried to comprehensively document the wide panorama of the existing tools from 2003 to 2015. Through a literature review the authors identified twenty-nine digital learning design tools and analysed them through a framework they proposed. This work does not cover all the available tools (it does not include, for example, EDIT2 (Sobreira & Tchounikine, 2012)) but it provides an interesting overview. Regarding the progression in the development of the tools, the most intense period seems to be between 2007 and 2011 during which twenty tools were developed. Commitment to tool development declined in subsequent years: from 2012 to 2015, only two tools were developed.

Celik and Magoulas (2016a) analysed the tools adopting the categories suggested by Persico and Pozzi (2015), namely 1) authoring and sharing tools; 2) reflection tools and pedagogical planners; 3) repositories and 4) delivery tools; to these categories they added a last category 5) assessment planners and learning analytics.

Persico and Pozzi (2015) includes in the category of authoring and sharing tools those which "*allow the representation of activities and are rooted in specific*

pedagogical models' or tools which 'allow different representation/visualisation of the same activity or flow of activities" (p.241). The authors cite as exemplar tools in this category, Web Collage (Villasclaras-Fernández, Hernández-Leo, Asensio-Pérez, & Dimitriadis, 2013), which is a pattern based tool aiming at representing collaborative learning activities through collaborative learning flow patterns (Hernández-Leo et al., 2006a) and CADMOS (Boloudakis, Retalis, & Psaromiligkos, 2018) which is a graphical learning design tool allowing to produce two different models: a conceptual model (in which the learning activities and the related resources are described) and a flow model (which describes the orchestration of the activities). According to Celik and Magoulas (2016a) eighteen out of twenty-nine tools belong to this category (see Table 2.1).

The second category corresponds to reflection tools and pedagogical planners. Persico and Pozzi (2015) include in this category tools oriented to support the reflection on pedagogical choices, for example: LDShake (Hernández-Leo, et al., 2011) a web tool aimed at supporting social sharing and co-edition of learning designs by teachers, and Phoebe (Masterman & Manton, 2011) which offers the teachers guided paths for supporting the process of planning and encourages them to explore new approaches and tools. Celik and Magoulas (2016a) include six tools in this category, as reported in Table 2.1.

To the third category, which includes repositories, belong tools aiming at providing the teachers with best practices, success stories and design ideas (Persico & Pozzi, 2015). The examples cited are Clowdworks (Conole & Culver, 2010) a tool for sharing learning and teaching ideas, and the Design Principles Database which has the aim of synthesizing the design knowledge about the use of technologies for education (Kali, 2008). Celik and Magoulas (2016a) include three tools in this category (see Table 2.1).

The fourth category refers to the tools that are conceived for the delivery of learning activities to students. To this category belongs GLUE!PS (Prieto, Asensio-Pérez, Dimitriadis, Gómez-Sánchez, & Muñoz-Cristóbal, 2011) a tool developed to deploy learning designs authored with multiple Learning Design tools, like Web Collage or the Pedagogical Planner (Pozzi, Ceregini, Dagnino, Ott, & Tavella, 2015) and expressed in a *lingua franca* into multiple learning management systems.

The last category mentioned by Celik and Magoulas (2016a) refers to assessment planners and learning analytics, and includes tools focused on informing learning in terms of learning analytics. As shown in Table 2.1, only one tool was included in this category: Map My Programme (Kerrigan, Headington, & Walker, 2011). The tool employs a set of free Google Apps to graphically display data for each course/unit/module, the types of assessment used across a programme and how it affected the learner's progression (see Table 2.1).

The overview provided by Celik and Magoulas (2016a) confirms what was already noted by Persico and Pozzi (2015), namely that research groups tended to work independently on the development of Learning Design tools with a consequent risk of fragmentation of the field. An attempt to integrate the results of some of the different 'streams' was carried out with the development of the Integrated Learning Design Environment (ILDE) which embeds several of the above-mentioned tools and offers guidance for the selection of the tool in relation to users' needs (Hernández-Leo, et al., 2013). To the best of my knowledge, the ILDE was the only experience of integration in the field.

Table 2.1 - Categories of Learning Design tools (Celik & Magoulas, 2016a)

Category	*Tools*
Authoring and sharing tools	ILDE (Hernández-Leo, et al., 2013), HKU LD Studio (Mor & Mogilevsky, 2013), Learning Designer (Laurillard et al., 2013), CeLS (Ronen, Kohen-Vacs, & Raz-Fogel, 2006), Web Collage (Villasclaras-Fernández,et al., 2013), DialogPlus (Conole & Fill, 2005), MOT+ (Paquette, Leonard, & Lundgren-Cayrol, 2008) LAMS (Dalziel, 2003), CADMOS (Boloudakis, et al., 2018), OpenGLM (Derntl, Neumann, & Oberhuemer, 2011), Compendium LD (Brasher, et al., 2008), eXe Learning[1], Reload (Griffiths, Beauvoir, Liber, & Barrett-Baxendale, 2009), Recourse (Griffiths et al., 2009), Copper Core[2]
Reflection tools and pedagogical planners	Pedagogic Pattern Collector[3], Phoebe (Masterman & Manton, 2011), LdShake (Hernández-Leo, et al., 2011), OpenScenario (Jullien, Martel, Vignollet, & Wentland, 2009), Lams AP (Cameron, 2009), Pedagogical Plan Manager (Olimpo et al., 2010)
Repositories	Clowdworks (Conole & Culver, 2010), HEART (Donald & Blake, 2009), LD Tool (Agostinho, 2011)
Delivery tools	GLUE!PS (Prieto et al., 2011)
Assessment planners and learning analytics	Map My Programme (Kerrigan et al., 2011)

[1]https://exelearning.org/;[2]https://coppercore.sourceforge.net/;[3]https://www.ld-grid.org/resources/tools/ pedagogical-pattern-collector

Looking at the progression of tool development since the publication of Celik and Magoulas (2016a), it is evident that the effort in this direction has been lim-

ited compared to previous years. A review of the available literature showed that from 2016 to date, eight tools have been designed or fully developed:

- The 4Ts game (Pozzi, Ceregini, & Persico, 2016): a hybrid game (initially a paper board game), for teachers who can co-design collaborative activities. The game is based on the 4Ts model (Pozzi & Persico, 2013) and makes use of a board and decks of cards.
- FROG (Håklev, Faucon, Hadzilacos, & Dillenbourg, 2017): a web-based tool for building and running collaborative pedagogical scripts, which also allows orchestration in real time.
- LA4LD (Schmitz, Scheffel, van Limbeek, Bemelmans, & Drachsler, 2018): a tool created with the collaboration of teachers and students, based on analytics which allows teachers to get feedback so that they may improve the design during the runtime phase.
- edCrumble (Albó & Hernández-Leo, 2018): an online learning design platform that allows the creation and sharing of blended learning designs with the support of data analytics.
- Le Planner (Kurvits, Laanpere, Väljataga, & Robtsenkov, 2019): an open-source software based on the approach of trialogical learning (Hakkarainen & Paavola, 2009); the tool provides a visual interface to create, visualise and share pedagogical scenarios.
- Balanced Learning design Planning (BDP) (Divjak, Grabar, Svetec, & Vondra, 2022): a tool which aims to help the teachers plan, by aligning program and course level learning outcomes and that uses learning analytics.
- A MOODLE oriented authoring tool for connectivist activities (Bakki & Oubahssi, 2022) based on the business process model and notation (BPMN) language, which was developed to facilitate the deployment of courses in MOODLE.
- EdVee (Trowsdale & McKay, 2023): a course design tool which supports pedagogical innovation allowing to visualize (and share) the constructive alignment (or non-alignment) of learning outcomes, content, learning and teaching activities and assessment.

Observing the evolution of tools development, it can be said that at the beginning the focus was more on the conceptualization and authoring of the designs (see for example LAMS (Dalziel, 2003) or more recently Web Collage (Villasclaras-Fernández, et al., 2013)), while through the years it shifted towards implementation (see for example FROG (Håklev et al., 2017) or LA4LD (Schmitz, et al., 2018)). Indeed, as it will be discussed in the following section (2.4.2), greater attention has been paid towards solutions able to support the implementation of designs into learning management systems.

Another significant change in the field that was detected by Prieto, Dimitriadis, et al. (2013) regarded the shift from the concern about data modelling of the first period to the issue of usability and conceptual support for practitioners. These changes probably indicate a greater attention towards the needs of those (teachers and practitioners) who are expected to be the beneficiaries of the results of the efforts in this research field. As highlighted by Wasson and Kirschner (2020) more recently, the focus was put on the relation between Learning Design and learning analytics, and how these learning analytics can support the design process; indeed, some of the tools developed in the last period rely on learning analytics to improve the design process, showing a great interest of the research groups towards this topic. Indeed, as Lockyer, Heathcote and Dawson (2013) highlighted, learning analytics may support learning designs implementation and redesign, grounding on students' behaviours and learning outcomes.

2.4.2 Comparing Learning Design approaches and tools

Given the growing number of approaches and tools available, comparative studies have been used over the years to reflect on the different perspectives provided, and on the issues and challenges in the field. This approach was taken the first time during a workshop at the ICALT 2006 conference (Vignollet, David, Ferraris, Martel, & Lejeune, 2006) and afterwards in a journal special issue, involving the same research groups of the conference, in 2008 (Vignollet, Martel, & Burgos, 2008). The comparative studies cited were based on the modelling of the same case study (the Planet Game) with different approaches and had the aim of understanding if existing educational modelling languages and the tools associated could be used to design and enact Computer Supported Collaborative Learning (CSCL) situations. Hereunder the approaches and tools compared in 2006 and 2008:

- Collage and Gridcole (they use IMS LD, Hernández-Leo et al., 2006b)
- Reload LDE and Coppercore (they use IMS LD, Tattersall, 2006)
- MOT+LD (they use IMS LD, Paquette & Léonard, 2006)
- F-logic complemented with the use of Reload LDE and Coppercore (Amorim, Lama, & Sánchez, 2006)
- LAMS (Dalziel, 2006)
- ModX and LDI (they use LDL, Martel, Vignollet, & Ferraris, 2006)
- CPM with Objecteering and UML profile (Nodenot & Laforcade, 2006)

These studies triggered other reflections over the Learning Design field contributing to identify and understand the problems and supporting the communication among the different research groups (Vignollet, Ferraris, Martel, & Burgos,

2008). The first consideration was about the need for authoring tools suitable for the end users (teachers and practitioners), which should be simple and not linked to the complex technical languages that represented the initial focus of several research groups in the field (see for example IMS-LD, Koper 2002). Most of the tools proposed in 2006 required using an Extensible Markup Language (XML) editor to complete the design, requiring teachers' technical skills. Between 2006 and 2008 all the groups involved in the comparative study developed an authoring tool based on a graphical language to support the Learning Design process in a user-friendly way, addressing the point highlighted in 2006. Another issue discussed was the capability of the solutions proposed by the different research groups to cover the different phases of the design. The phases were conceptualized as design (the modelling phase), operationalization (in which there is the deployment in the learning environment) and execution (in which there is the enactment). According to the analysis that emerged from the special issue (Vignollet, Martel, & Burgos 2008), the idea of a linear sequence of phases could be considered outdated and the process should be approached in a more flexible way; for this reason, authors concluded that tools should be capable of managing all phases. Finally, another relevant issue raised was the integration of the design-time and run-time so that the design can be changed and improved based on data; at the time of the special issue the tools offered limited support for data monitoring. As it will be discussed in chapter 4, these two points, flexibility and coverage of the whole design cycle, have been discussed in the literature and have been identified as possible obstacles to the teachers' adoption. In 2013 the comparative approach was again adopted in a tandem of studies (Persico et al., 2013; Prieto, Dimitriadis, et al., 2013). The first one compared several Learning Design approaches while the second one compared some tools covering the whole Learning Design lifecycle. As in the previously mentioned studies, the same scenario was designed by several research teams. In the first paper by Persico et al., (2013) five approaches were compared:

- The 4SPPIces Model (Pérez-Sanagustín, Santos, Hernández-Leo & Blat, 2012): a model developed for supporting the design of Computer Supported Collaborative Blended Learning.
- The 4Ts model (Pozzi & Persico, 2013): developed for supporting pedagogical planning and decision making in Computer Supported Collaborative Learning.
- The e-Design Template (Walmsley, 2015): a template based on constructivist principles which aims to support the process of designing e-learning.
- The Design Principles Database (DPD): (Kali, 2008): an approach based on the collection of principles for socio-constructivist Learning Design.

- The Design Narrative (Mor, 2011): which approaches the design as a problem-solving process, describing a problem, the actions taken to solve it and the consequences.

Each of the five approaches provides a conceptual framework to support who is designing for learning to make decisions and reflect on these decisions, but at the time of the study only two of them (the 4SPPIces and DPD) had a technological support.

The main concern that emerged from the comparison was the coverage of the entire design cycle. Indeed, all the approaches considered supported the first phases of the design process but not the enactment of the design, even though great emphasis was put in that period on the orchestration, reflection and redesign that are linked to the enactment. Another issue raised was the need of tools which could scaffold the teacher in learning an approach and fruitfully adopt it.

In the paper of Prieto, Dimitriadis, et al. (2013) five Learning Design tools have been compared:

- The Learning Designer (Laurillard et al. 2013): a community knowledge building tool for teachers to plan and reflect.
- OpenGLM (Derntl, Neumann, & Oberhuemer, 2011): a graphical authoring tool supporting the design of IMS-LD compliant units of learning.
- CADMOS (Katsamani & Retalis, 2011): a graphical tool, which is also compatible with IMS-LD.
- Web Collage (Villasclaras-Fernández, et al., 2013): a graphical tool for teachers not expert in LD for designing collaborative learning, it supports IMS-LD.
- ScenEdit (Emin, Pernin, & Aguirre 2010): a web-based tool for designing and sharing learning scenarios which supports the visual representation of three dimensions related to teachers' intentions, teaching methods and strategies.

These tools cover the different phases of the design process.

Conclusions drawn from the comparison were about the suitability of the different tools to design for both face-to-face and online education. In particular, the authors highlighted that the tools which ground on IMS-LD specifications (i.e., OpenGLM, CADMOS and Web Collage) seemed more useful for designs to be implemented in digital environments such as learning management systems (LMS) while the ones based more on natural language descriptions and activity types resulting from teaching practice (e.g., the Learning Designer) for face-to-face education. These studies confirmed a hypothesis already shared among the researchers in the field that the idea of 'one size fits for all' is not suitable in this context; this finding was valid for both approaches and tools since they tackle different aspects of the design process or they are inspired by different learning

theories (Persico et al., 2013). Nonetheless, as discussed above, this richness could become an obstacle to the teachers' adoption since they need to explore different options before finding the most suitable for their needs and this requires an effort that should be counterbalanced by perceived advantages.

2.4.3 The adoption of Learning Design methods and tools: an open issue

The sections above aimed at presenting the wide variety of methods and tools developed in the last decades, as well as the main issues and challenges identified by the researchers in the field. According to several researchers (Asensio-Pérez, et al., 2014, Hernández-Leo, et al., 2018), despite the considerable effort put by the different research groups, teachers' attitude toward Learning Design methods and tools remains of moderate interest. Nevertheless, the lack of adoption has not been systematically studied by researchers in the field, but mainly observed and studied in specific research contexts. For example, Neumann et al., (2010) studied the factors hindering adoption of IMS-LD specifications; the authors concluded that the complexity of specifications associated with the lack of functionality required by the community, the scarce implementation in the organizations due to changes required, as well as cultural and technological hurdles may be identified as relevant factors. This study represented an advancement in the comprehension of the barriers to the adoption IMS-LD specifications.

Asensio-Pérez et al. (2017), tried to summarise the findings of different researchers, identifying three areas in which the main barriers to adoption may be found: 1) characteristics of Learning Design tools; 2) teachers' mindset; 3) teacher training.

As far as first area, which refers to the characteristics of Learning Design tools, Asensio-Pérez et al. (2017) cite the capability of the tools to be flexible enough to allow the integration of different solutions, to support all the phases of the design process and to provide support to the community of designers (Bennett, et al., 2015; Mor, Craft, & Hernández-Leo, 2013; Voogt et al., 2011). The issues of flexibility and of coverage of the 'full cycle' were discussed as weaknesses of existing tools in the comparative studies reported in section 2.4.2. The coverage of the 'full cycle', in particular, was openly identified as an obstacle by Mor et al. (2013), who highlighted the importance of interoperability between Learning Design tools and online learning environments supported by the educational institutions.

The second area is related to teachers' mindset, moving the focus from the methods and tools to the users; grounding on Dimitriadis and Goodyear (2013) analysis, Asensio-Pérez et al. (2017) consider a change of teachers' mindset necessary to favour the practice of the design of the learning activities.

The last area is related to teacher training. Studies by Bennett et al. (2017) and Maina et al. (2015) highlight the importance of professional development to promote the uptake of Learning Design tools and practices. In this line Asensio-Pérez et al. (2017) focus their contribution on the interplay between training and tools for Learning Design, concluding that a tool capable to support the complete design process is beneficial in training actions on Learning Design.

The value of this analysis lies in having associated obstacles related to tool characteristics with aspects that are also cross-cutting and significantly influence teachers' choices: the teacher's mindset and the role of the training.

An interesting study linked to the issue of adoption was proposed by Celik and Magoulas (2016b), who carried out a literature review aimed at providing a general overview on teachers' perspectives, practices and needs related to Learning Design tools. Even though the analysis included a few papers (six) meeting the authors' inclusion criteria (year range, focus on teachers in higher education), it gives insights on the teachers' experience and needs. The authors highlighted that higher education teachers were very positive towards the use of support tools in their design for learning but that the available tools did not match teachers' design strategies. As far as the needs, the authors found that the studies converged on the conclusion that tools should provide guidance for the full design process and at the same time be flexible; among other needs, authors reported: ready-to-use design templates (Masterman, Walker, & Bower, 2013; Prieto, Tchounikine, Asensio-Pérez, Sobreira, & Dimitriadis, 2014) learning analytics (Bennett et al., 2015), recommended learning designs which users are allowed to edit (Laurillard et al., 2013), coherence with the teachers' design thinking (Masterman et al., 2013) and support for sharing and reusing (Masterman & Manton, 2011). Celik and Magoulas (2016b) conclude that what they call 'the next generation of Learning Design tools' should be developed with a clear focus on teachers' needs more than on researchers' interests.

This reflection highlights the second aspect I think should be considered when studying the barriers to adoption: teachers' needs. Indeed, the lack of adoption could be the result of a mismatch between the proposed methods and tools and the teachers' needs.

In this thesis I decided to assume a double perspective and investigate both needs and barriers to the adoption of Learning Design methods and tools.

2.5 Conclusions

This thesis work aims at addressing the question of adoption of Learning Design methods and tools in a systematic way, since it remains an open issue in the field. In this chapter, I have presented the origins of the research field of Learning

Design, the evolution over time as far as the development of methods and tools, and the challenges that have emerged. These challenges such as the problem of flexibility of the tools and the possibility of adapting them to different contexts or approaches, or the coverage of the design life cycle, have been identified over the years as possible obstacles to the adoption of methods and tools by some researchers in the field.

This chapter aimed to clarify the context of the thesis and outline the background to the study of factors that might influence teachers' decision to adopt or not Learning Design methods and tools. In the following chapters the core of the thesis work will be described. Chapter 3 reports the design of the research and the methods adopted. The first step in the process was a systematic literature review focused on teachers' needs and existing barriers to adoption whose results are reported in chapter 4. In chapter 5, I describe the Delphi study that was carried out afterwards, to collect experts' opinions about the approach taken (identification of needs and barriers) and the findings of the review; experts were also asked to identify possible actions/solutions for supporting adoption. In parallel, a case study was conducted to study the needs and barriers in the field and to test some actions/solutions in an ecological context. The case study is presented in chapter 6.

Chapter 3
Methodology

Chapter 3 presents the methodology adopted in carrying out this thesis work. First of all, the research approach is described; the philosophical worldview underpinning this study (pragmatic) was selected since it focuses on a problem and its solution, which is exactly the situation I was addressing as described in the previous chapters. The pragmatic approach leaves the researcher free to select the most suitable method, so in this chapter I describe how the mixed method research was identified as the most adequate for the aim of the study, the complexity of the research subject and the multiple actors involved. Then the overall research design and all its phases are described, which include a systematic literature review, a Delphi study, and a case study. In this chapter, these three methods are described from a theoretical perspective, while the ways in which they were implemented in the thesis work are described in depth in chapters 4, 5 and 6. At the end of this chapter, the ethical aspects and the issue of trustworthiness of this thesis work are discussed.

3.1 The research approach

The first step in research is to establish the research approach. As written in the Introduction (see section 1), the research approach is informed by the researcher's philosophy and worldview (Creswell, 2014; Creswell & Creswell, 2018); the latter also intertwines with the methods and the design of the research. While consistency across the ontological, epistemological views and the final decisions on methods and research design is beneficial, flexibility may be also necessary to address the methodological issues that may emerge (Twining, Heller, Nussbaum, & Tsai, 2017).

In her work, Mertens (2010) presents four worldviews:

1. Post-positivist
2. Constructivist
3. Transformative
4. Pragmatic

Each of these worldviews starts from different assumptions and ends with different outcomes, each entailing different research methods.

Thus, the post-positivist worldview is grounded on determinism, according to which there are causes determining effects or outcomes. With this approach, a researcher begins with a theory, collects data that can support or contrast the theory and proceeds along this line. Usually, the design of the research is based on quantitative methods. This worldview is not suitable for specific phenomena (for example a human behaviour that needs to be studied in ecological settings), since sometimes a cause-effect relationship is not identifiable, or several variables affect the phenomenon.

The constructivist worldview aims to interpret or make sense of other people's meanings about the surrounding reality and instead of starting from a theory, the researcher develops a theory out of the field work. The elective research methods are qualitative (Creswell, 2014, p.8).

The transformative worldview claims that research inquiry needs to be intertwined with politics and it focuses on the needs for change, equity, or solidarity. Therefore, its scope may be more limited, e.g., it may be less applicable to exact or natural sciences, but more applicable in social sciences. With the pragmatic worldview the focus is on the research problem and the aim of the research is not (dis)confirming a theory or developing a new theory from data, but rather proposing solutions to a problem (Creswell, 2014, p.9).

The phenomenon subject of my study presents the characteristics of a problem to be studied (the lack of adoption of Learning Design methods and tools) and requires to be studied in the environment in which it emerges: the educational institutions. Thus, pragmatism is the most suitable philosophy to approach the issue addressed in this thesis.

In relation with the methods to adopt in the thesis, the pragmatic approach leaves the researcher free to choose the methods and procedures that best match the specific problem and the research question addressed. Interestingly, pragmatism is considered the philosophical foundation of mixed methods studies (see Morgan (2007) and Tashakkori & Teddlie (2010) cited by Creswell, 2014 p.11) because it underlines the importance of using pluralistic approaches to acquire knowledge about a problem. Given this consideration and in the light of the complexity of the problem and the variety of data sources, I opted for a mixed methods approach.

3.2 The mixed methods approach

Mixed methods research is an approach that combines both qualitative and quantitative data collection and analysis techniques (Creswell & Plano Clark, 2007). This complex methodological approach has its strength in the use of multiple methods of data collection and analysis for the purpose of increasing the reliability of the results and conclusions reached, thanks to the possibility of triangulating different aspects of the research (data, techniques, contexts, etc.).

Mixed method designs therefore include both quantitative and qualitative data and Creswell (2014, p.15) identifies three basic approaches to mixed methods research designs:

- **Convergent parallel mixed methods:** this approach entails the parallel collection of qualitative and quantitative data, their separate analysis, and the comparison of results to confirm or disconfirm the findings.
- **Explanatory sequential mixed methods:** it entails a two phases' data collection; the first quantitative phase is followed by a qualitative phase.
- **Exploratory sequential mixed methods:** the research starts by exploring with qualitative data collection and is followed by a quantitative phase.

These three basic models can be combined in more complex models such as for example:

- **The embedded mixed methods** that involve either the convergent or sequential use of data; quantitative or qualitative data are embedded within a larger design.
- **The multiphase mixed methods design** (common in the fields of evaluation) in which concurrent or sequential strategies are used over time to best understand a long-term program goal.

As I will explain in section 3.3, the present study was built following an 'explanatory sequential' design (Creswell, 2014) and envisages a 'quantitative-qualitative-interpretation' sequence.

According to Greene, Caracelli, & Graham (1989), designing mixed methods research can have different purposes. In a theoretical review of the field, they identified five purposes for mixed methods:

- **Triangulation:** studies with a triangulation intent seeks convergence or correspondence from different results to minimize the errors due to different sources of bias (methods, inquirers, contexts, etc).
- **Complementarity:** studies with this purpose use qualitative and quantitative methods to measure correspondence but also different facets of a phenomenon, pursuing a more elaborated understanding of it.
- **Development:** studies with this intent aim to use the results from one method to inform the other method or develop it.

- **Initiation:** studies having an initiation purpose seek to discover paradoxes or to generate fresh perspectives on the phenomenon under study.
- **Expansion:** studies with an expansion intent aim at extending the range of the inquiry by using different methods for the various components of a given phenomenon.

Among the above-mentioned purposes identified for mixing in mixed methods research, in this thesis I was guided by the intent of triangulation and complementarity, as it will be further explained in section 3.3.

3.3 The overall research design

As already explained, the research design grounds on mixed methods, due to the nature of the phenomenon studied that is a problem (the lack of adoption by teachers of Learning Design methods and tools), the multiple sources of information and the different types of data (quantitative and qualitative) that can be collected. In relation to the sources of information, both researchers and teachers can be considered informants bringing different points of view. As said in section 1.3, the types of data that can be collected to frame and understand the phenomenon are also diverse:

- The already existing literature whose analysis is the necessary premise on which to build upon.
- Opinions/subjective views of experts/researchers in the field about the findings deriving from the analysis of the literature and the emerging explanations regarding the lack of adoption.
- Data from the use of Learning Design tools collected in the field, that could represent a useful source for exploring the issue of adoption from the point of view of teachers.

Thus, the methods identified to collect the above-mentioned data are the following:

- A systematic literature review (Petticrew, 2001) to explore the available literature on Learning Design, guided by research questions derived from the RQ1 of the thesis, i.e., *What are the factors affecting the adoption of Learning Design methods and tools?*.
- A Delphi study (Dalkey & Helmer, 1963) to collect the opinions of a group of experts in the field and explore the level of consensus among them about the factors affecting adoption and possible solutions to support adoption.
- A case study (Stake, 1995) to collect field data on needs and barriers, and also on the possible solutions tested in that context.

As described in the section above (3.2), the design of the thesis work derives from the 'explanatory sequential' design as defined by Creswell (2014) that envisages a 'quantitative-qualitative-interpretation' sequence.

In this specific case, the methods were innerly mixed, namely qualitative/quantitative data collection methods are integrated:

- The systematic literature review was mainly quantitative but also contained qualitative aspects; it was aimed at identifying a list of factors (teachers' needs and barriers to adoption) which could inform both the case study and the Delphi study.
- The Delphi study and the case study were mainly qualitative, but also included quantitative elements. The aim of these two methods was to further explore the factors affecting adoption with experts and teachers and to identify possible solutions to support adoption and test them.

The design of the thesis work is represented in Figure 1.2.

As pointed out in section 3.2, the design based on mixed methods had the purpose both to triangulate and complement findings.

In particular, triangulation was pursued within the case study, using multiple data collection techniques. Triangulation and complementarity were pursued through the different methods (systematic literature review, Delphi study and case study) thanks to which I found correspondence in findings about teachers' needs and barriers to adoption and I was able to explore the different facets of the phenomenon.

The design of the research was described in a paper (Dagnino, Dimitriadis, Pozzi, Rubia-Avi & Asensio-Pérez, 2020) in which the methodological implications of the use of technologies to support the different methods and the overall design were also discussed. The use of technologies to support the research had an impact both at the level of each single method and the whole process.

In the following sections, the three methods are described theoretically while their instantiation in the thesis work will be described in the dedicated chapters (4, 5 and 6). The above-mentioned implications of the use of technologies for each single method will be analysed in the related chapters.

3.3.1 Systematic Literature Review

Literature reviews are studies oriented to the analysis of the scientific literature about a specific topic; two most common types of reviews are narrative and systematic reviews (Petticrew, 2001; Rother, 2007). Narrative reviews describe the state of the art about a specific topic or theme but tend to approach it from a general point of view and without specific research questions. Moreover, in this type of review the methodology adopted and the procedure followed are not de-

scribed, making the study not reproducible, and data are analysed mainly from the qualitative viewpoint. This type of review plays an important role since it provides an update of the literature in a specific field. On the other hand, a systematic literature review has, generally, the aim of identifying, selecting and analysing the published research on a topic in order to answer a research question. A systematic review usually relies on a protocol that sets the criteria for the search and analysis of the available literature; it is based on a transparent search conducted over multiple databases and grey literature; a clear description of methodology and procedure ensures that the review will be replicable and comprehensive (Lame 2019; Petticrew, 2001; Rother, 2007).

In the present case, the systematic literature review was considered the most proper way to analyse the literature since I had the aim of answering the RQ1, namely, to study the factors affecting the adoption of Learning Design methods and tools. In particular, the critical analysis of the literature available was carried out looking at the emerging teachers' needs and barriers to adoption.

There are several protocols and guidelines that can be followed to carry out systematic literature reviews that have been developed in different research areas (e.g., medicine, engineering). The review carried out for the thesis followed the guidelines proposed by Kitchenham and Charters (2007). I selected these guidelines despite the fact they have been conceived for the software engineering research area, because they are based on existing guidelines in other disciplines, including social sciences and they have been applied in the field of Technology Enhanced Learning (see for example Rodriguez-Triana et al., 2017).

Kitchenham and Charters (2007) guidelines identify three main phases in systematic reviews (planning, conducting and reporting) and for each of these phases identify specific stages.

The stages associated with planning the review are:

- identification of the need for a review
- commissioning a review (optional)
- specification of the research question(s)
- developing of a review protocol
- evaluation of the review protocol (optional).

The stages associated with conducting the review are:

- identification of research
- selection of primary studies
- study quality assessment
- data extraction and monitoring
- data synthesis.

The stages associated with reporting the review are:

- specification of dissemination mechanisms

- formatting of the main report
- evaluation of the report (optional).

The systematic literature review was carried out following the mandatory stages and the main points suggested by the authors were carefully considered. The way the protocol has been applied and the results of the review are described in chapter 4. These results informed the subsequent phases of the research design.

3.3.2 Delphi study

The Delphi method is a group technique born for forecasting and typically used to aid in decision-making based on the opinions of experts *(*Landeta, 2006). The aim of the technique is to reach "*the most reliable consensus of opinion of a group of experts. It attempts to achieve this by a series of intensive questionnaires interspersed with controlled opinion feedback*" (Dalkey & Helmer, 1963, p. 1). According to Landeta (2006), through the years the aim of reaching consensus was surpassed and it is now considered a technique for obtaining a reliable expert panel's opinion (not necessarily consensus). The technique was adopted initially in the military context but afterward it was also employed in technological forecasting and complex social problems evaluation. Regarding the Technology Enhanced Learning field, the method has been employed in several research studies (e.g., Plesch, Kaendler, Rummel, Wiedmann, & Spada, 2013; Porta, Mas-Machuca, Martinez-Costa, & Maillet, 2012; Pozzi et al., 2019). Although the Delphi method is described as a group communication process, it exclusively entails phases of individual consultation of experts; no direct interactions among the participating experts is expected so to avoid undesired effects like inhibition, defence of the position taken, or the tendency to sway towards other participants' positions (Dalkey & Helmer, 1963). According to Landeta (2006) the main characteristics of the method are:

- Repetitiveness - the experts are consulted repeatedly (at least twice on the same question); this allows experts changing or reconsidering the positions in the light of the opinions collected from the others.
- Anonymity – participants do not know each other's identity.
- Controlled feedback – information and ideas exchange is mediated by the study proponent, including the feedback regarding the position of the whole group.
- Group statistical response - both qualitative and quantitative data analysis methods can be adopted. In the final rounds, questions are formulated so as to carry out a statistical analysis of the results at group level.

A Delphi study entails the participation of a selected group of experts with a high level of expertise in the topic (Ziglio, 1996). The experts to be involved can be identified following structured procedures, like the one proposed by Delbecq, Van de Ven, & Gustafson (1975) for selecting the panel of experts for the nominal group technique. However, convenience samples are quite common, given that the researcher may have an adequate knowledge of experts in the area of interest (Skinner, Nelson, Chin, & Land, 2015). Rowe and Wright (2001) suggest composing the panel with heterogeneous experts. According to Hsu and Sandford (2007) the sample should consist of people who are highly trained and have specialized knowledge in the target area (positional leaders, authors of publications in the area of study, and stakeholders who have firsthand understanding of a particular issue). There are no specific indications about the size of the panel, but considering the level of expertise required, the panel is usually between 10 and 30 experts (Skinner et al., 2015).

The Delphi method is characterized by rounds (von der Gracht, 2012). The Delphi study usually begins with an open-ended questionnaire that is given to the panel of experts to request specific information on a subject that is, then, transformed into a list of items. In the following rounds, the panel rates the relative importance of individual items and makes changes to the form or contents of the items themselves; consensus may be reached after a certain number of rounds. Custer, Scarcella and Stuart (1999) proposed a modified model based on a change at the beginning of the process: the open-ended questions round is skipped, and the Delphi study begins with the rating of a set of carefully selected items proposed by the researcher. These pre-selected items may be drawn from various sources, e.g., competency profiles, synthesized reviews of the literature, and interviews with selected content experts. According to the authors, this modification typically improves the initial round response rate, and provides a solid foundation in previously developed work. There is not a pre-defined number of rounds: two rounds are considered acceptable if there is a clear literature base (Iqbal & Pipon-Young, 2009), but three or more can allow yielding consensus (Custer et al., 1999; Rowe & Wright, 2001).

The Delphi method presents both advantages and shortcomings that need to be considered by the researcher before adopting it. Hung, Altschuld, and Lee (2008) relied on several papers analysing these aspects and summarized them in a table (p.192) that provides a clear view of both sides. Hung et al. (2008) show that some of the main strengths of the method are also associated with potential drawbacks. For example, the multiple rounds for reaching consensus may lead to lower response rates or to time delays between rounds or may force compromise rather than consensus. Another example is anonymity, the purpose of which is to avoid group pressure and direct confrontation that may influence the expression of opin-

ions; on the other hand, anonymity may lead to a lack of sense of responsibility for the answers given and encourage quick responses.

In the case of this thesis, the Delphi method was identified as suitable since I was interested in collecting the opinions of experts in the Learning Design field regarding the relative importance of the two categories of factors (teachers' needs and barriers to adoption) as far as the adoption of Learning Design methods and tools, thus trying to contribute to future research avenues on Learning Design. The Delphi study was preferred to individual and other group techniques. Indeed, a questionnaire could have been limited in gathering opinions and, like individual interviews, could lose the value of comparing opinions. The group interview would have had the problem of direct confrontation between experts, which may be affected by personal relationships (friendship, power dynamics, etc.). The Delphi study, instead, thanks to anonymity and multiple rounds, allows one to express an opinion and confront it with the other experts' opinions without direct confrontation. Moreover, multiple rounds activate reflection and leave time to reconsider opinions in the light of feedback coming from previous ones. These are the reasons that lead me to prefer the Delphi method to others.

How the Delphi study was designed and carried out (panel selection, procedure, etc.) and its results are reported in chapter 5.

3.3.3 Case study

The case study is a method that is widely used in qualitative research in different research fields such as psychology, medicine, business and environmental sciences (Scholz & Tietje, 2002). In education, the method became popular in the 80's (Nath, 2005), nevertheless, there has not been a full consensus on its definition and on the design and implementation of case studies. As Yazan (2015) highlighted in his research, different scholars on methodologies propose different definitions and emphasise different aspects.

Yin (1994) for example, defines case study as:

"*…an empirical inquiry that investigates a contemporary phenomenon within its real-life context especially when the boundaries between the phenomenon and context are not clearly evident […]. The case study inquiry: copes with the technically distinctive situation in which there will be many more variables of interest than data points and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from a prior development of theoretical propositions to guide data collection and analyses*" (pp.13-14).

According to Yazan (2015), Yin (1994) looks at the case study from a positivist perspective, the approach is rigorous and defines every aspect of the research.

Yin pays special attention to the design of the case study, for which he sets conditions for the quality and identifies specific components; moreover, he defines the data sources and the techniques for data analysis since validity is one of his concerns.

On the other hand, Stake (1995) defines qualitative case study as "*…the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances*" (p. xi).

Stake followed a different approach from the epistemological viewpoint, in fact he states that constructivism and existentialism should orient and inform the qualitative case study research (Stake, 1995). The approach to the design is more flexible and allows the researcher to make changes also in the implementation phase. What he considers paramount are the research questions that help in structuring the data collection.

The blurred boundaries sketched by the different authors represent a challenge for the novice researcher who wants to apply the method but, at the same time, some communalities can guide the researcher in adopting it and designing the research: the centrality of the context, the multiple sources of data, the aim of making the case study exhaustive. These principles guided my decision to rely on this method to reach an in-depth comprehension of the phenomenon I was studying (the lack of adoption of Learning Design methods and tools and the solutions that could support it).

3.3.3.1 Types of case studies

Stake (2005) proposes a useful distinction among three types of case studies:

- **Intrinsic case study:** when one wants to better understand a particular case. The case is not representative of other cases but itself is the object of the researcher's interest.
- **Instrumental case study:** if a case is studied "*mainly to provide insight into an issue or to redraw generalisation"* (Stake, 2005, p. 445). The case itself is not the primary interest but it plays a supportive role for understanding a phenomenon. The case is studied in depth, anyway, and the context carefully examined. The case may be representative of other cases or not.
- **Multiple case study:** "*a number of cases may be studied jointly in order to investigate a phenomenon, a population or general condition*" (Stake, 2005, pp.445). It is a case study extended to several contexts.

The case in this thesis clearly belongs to the category of instrumental case studies, since I was interested in the adoption of Learning Design methods and tools, which is an issue that does not pertain to a specific case. A multiple case

study would have been also a suitable option for my purpose, but in this research work the case study complemented data collected with other methods (systematic literature review and Delphi study) and, as it will be described in chapter 6, it implied a long-term study. The limits in terms of time and availability of other real settings prevented me from carrying out a multiple case study.

3.3.3.2 Generic conceptual structure of a case study

Stake (2005) proposed a conceptual structure of case studies to which I referred for representing the case study in the thesis, since it provides a clear view of all the elements at play. The structure is shown in Figure 3.1.

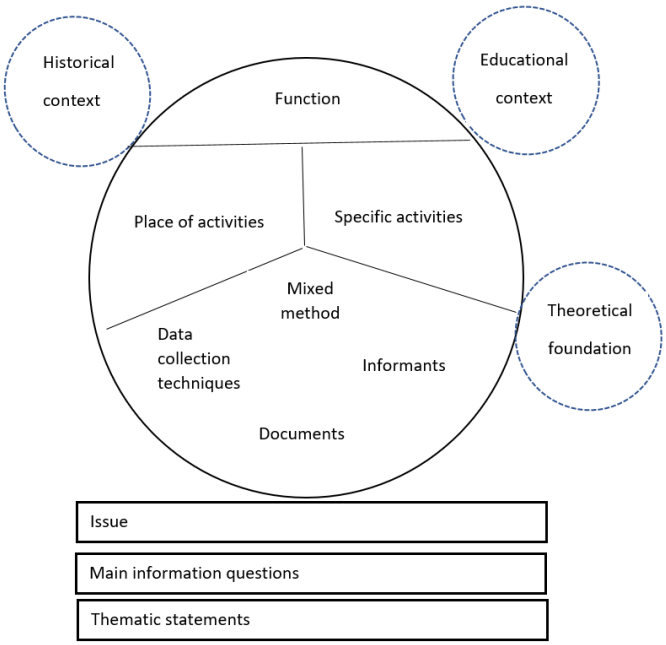

Figure 3.1 - Generic conceptual structure of the case study (adapted from Stake, 2005, p. 446)

In the structure depicted in the figure above, one can see at the top the contexts (historical and educational) in which the case develops. In the central part of the conceptual structure, information related to the main themes of the case appears, thus, the function of the case, the places where the data collection activities take place, as well as the techniques and instruments. At the bottom of the graph, the issues or tensions that guide the case study are shown, together with the main information questions and thematic statements.

The conceptual structure of the case study part of this thesis is presented in chapter 6, as well as its design and implementation. In the following section I just present a short theoretical reference to the design-based research paradigm (Design-Based Research Collective, 2003), which informed the design of the case study.

3.3.3.3 The design of the case study

The design-based research paradigm was developed to address different needs in educational research, among them the "*need for approaches to the study of learning phenomena in the real world*" (Collins, Joseph, & Bielaczyc, 2004, p. 16).

Wang and Hannafin (2005) define it as "*a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories*" (p. 6). Since I wanted to study the adoption of Learning Design in a concrete setting for a long period of time and I wanted to design and carry out specific interventions to study and support the process of adoption, design-based research seemed to be the most suitable option to guide the design of the case study.

This approach was identified for the following reasons that are clearly highlighted by Kaplan Akilli (n.d.):

- Design-based research is pragmatic, since it is aimed at addressing practical problems by designing and carrying out interventions and, in parallel, refining design principles grounding on theory.
- Design-based research is interactive, collaborative and flexible, characteristics that are desirable for research in concrete settings.
- Design-based research is integrative as far as theories and research methods. It utilizes mixed methods as a means to analyse the outcomes of an intervention and refine it (Design-Based Research Collective, 2003).
- Design-based research is contextualised, findings are the result of the interplay of the design processes and the setting where it is enacted (Wang

& Hannafin, 2005). This of course limits the possibility to generalize them but offers the opportunity of in depth understanding.

Moreover, literature points out that design-based research is successful if conducted "*with a single setting over a long time*" (Design-Based Research Collective, 2003, p. 7) that was my case.

In Figure 3.2, the generic model of design-based research is shown.

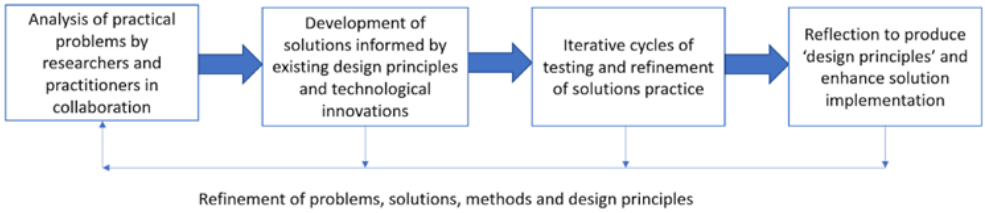

Figure 3.2 - Model of design-based research (adapted from Amiel & Reeves, 2008, p. 34)

3.4 Ethical aspects and trustworthiness of the research study

In this section I explore the issues a researcher needs to take under consideration in carrying out a study with human subjects, i.e., (1) ethical issues; (2) methodological rigour and trustworthiness:

1. **Ethical issues:** in carrying out research involving participants, it is necessary to comply with ethical regulations and guidelines (European Commission, 2021). In line with the EU Regulation 2016/679 (General Data Protection Regulation, 2016/679, GDPR) (European Commission, 2016), both the experts involved in the Delphi study and the teachers involved in the case study were informed about the objective of the research, data treatment (modality and duration) and their rights and were requested to give their informed consent before participating in the study and, then, providing their data (see Appendix 1. Data collection tools). With respect to the Delphi study, anonymity was preserved throughout the process: participants were given a code and contacts were managed through the online system for the questionnaire. Similarly, regarding the teachers involved in the case study, datasets and interview transcriptions were anonymized, names were replaced by codes that enabled cross reference data from different data collection tools.

2. **Trustworthiness:** being a mixed methods study I rely on the criteria and strategies proposed by Lincoln and Guba (1985) to ensure trustworthiness, that is a concept they introduced to address the issue of rigor in qualitative inquiry. These include:
    - **Credibility** (which corresponds to internal validity): Lincoln and Guba (1985) propose several strategies to ensure credibility, such as: prolonged engagement, persistent observation, triangulation, etc. As described in this chapter and in chapters 4, 5 and 6, multiple data collection and analysis methods (systematic literature review, Delphi study and case study) and tools were used in the study to be able to triangulate results. The systematic literature review was triangulated with the case study and the Delphi study, as far as the teachers' needs and barriers to adoption. In the case study, I used several tools like questionnaires, interviews and design analyses to triangulate data. Moreover, the case study implied a prolonged engagement since it was a long-term study (more than 2 years).
    - **Transferability** (which corresponds to external validity, or generalizability): as far as this criterion, the systematic literature review cross checked with the results of the Delphi study and the case study contributes to the generalizability of the conclusions about the teachers' needs and barriers to adoption (RQ1). The findings about the proposed solutions for supporting adoption (RQ2), tested in the case study, required resorting to the thick description (Lincoln & Guba, 1985) of the study, to put readers in the condition to judge the possibility of transferring the original findings to another context.
    - **Dependability** (which corresponds to reliability): this criterion relies on stability and consistency of data. Lincoln and Guba (1985) state it is attainable through credibility; in this case, the use of "overlapping methods" (triangulation) was the strategy to meet both criteria (credibility and dependability).
    - **Confirmability** (Objectivity): it seeks to demonstrate that the researcher's biases and tendencies have been minimised. This criterion was met using again the triangulation of data. Moreover, to minimise the biases derived from the involvement of the researcher, I relied on the participation of the thesis advisors and one external researcher.

3.5 Conclusions

This section was dedicated to the methodology adopted in the thesis. It had the aim to introduce the choices that were made and why they were made, exploring the theoretical underpinnings of the research approach and the specific methods that were implemented in the thesis. The philosophy that guided the thesis work (pragmatic) and the nature of the problem I was tackling led me to choose the mixed methods approach, so that I could involve different actors (the researchers who are experts in the field of Learning Design and the teachers who are the recipients) and have different sources of data. Two methods were identified to collect experts' research results and opinions. The first, the systematic literature review, allowed me to explore the literature grounding on precise research questions; the second, the Delphi study, was identified for its capability to foster an albeit indirect confrontation among researchers in the field. The case study was the method selected to analyse the adoption from the point of view of teachers and was identified since it allows to study a phenomenon in an ecological context. This chapter served as a necessary introduction to the following chapters 4, 5, 6 in which the implementation of the three methods in the thesis and their respective results will be discussed.

Chapter 4
Systematic literature review

This chapter reports the design, carrying out and results of the systematic literature review that was carried out during the first phase of the research work to answer the RQ1, namely, to study the factors affecting the adoption of Learning Design methods and tools. In particular, the critical analysis of the literature available was carried out looking at the emerging teachers' needs and barriers to adoption. The review was performed following the guidelines of Kitchenham and Charters (2007) and included research papers with primary studies that were not purely theoretical. The search was carried out in five main academic databases in Technology Enhanced Learning plus a search on Google about project reports; the corpus resulting from the search included 423 papers among which 26 papers plus 3 project reports were selected, published between 2010 and 2017. The review provides a systematic overview of the knowledge developed as far as the specified foci (teachers' needs and barriers to adoption) and makes evident some research gaps like the limited number of studies about teachers' actual design practices and the lack of research about barriers to adoption; moreover, the results show the lack of long term or follow up studies about the adoption of Learning Design methods and tools. At the end of the chapter, it was added an update of the literature review carried out after the conclusion of the dissertation, in 2023, to show how the research in the field has evolved in the last years.

4.1 Introduction

The analysis of the existing literature is the necessary premise to any research work; for this reason, the first step of the research study was a critical analysis of the available literature in the light of RQ1.

The systematic literature review conducted for this thesis work approaches the lack of adoption of Learning Design methods and tools claimed by some re-

searchers in the field (see, e.g., Asensio-Pérez, et al., 2014; Bennett et al., 2017; Hernández-Leo, et al., 2018) as a primary research problem. As written in section 1.1 and in section 2.4.3, despite the attention towards the issue, there is a lack of studies dedicated to understand the reasons behind the lack of adoption as a problem affecting Learning Design methods and tools in general. Indeed, most studies are dedicated to single methods and tools. For example, Neumann et al. (2010) explored the problems in adopting the specifications of IMS-LD. Other studies, oriented to understand the adoption in general, take a single perspective, like Celik and Magoulas (2016b) who focus on teachers' perception of tools and their needs.

While teachers' needs are clearly important to understand the adoption, what seems to have been scarcely studied in prior studies are the barriers that can prevent it. Only Asensio-Pérez and colleagues (2017) tried to summarize findings of different studies identifying three main areas: [1] characteristics of tools for Learning Design, [2] teachers' mindset and [3] teachers' training about Learning Design (see section 2.4.3).

Since barriers have been thoroughly studied as far as technology integration in teaching (Ertmer, 1999; Hew & Brush, 2007), I consider that a similar point of view can be useful in studying the adoption of Learning Design methods and tools.

Therefore, the review carried out for the thesis approaches the issue of factors affecting adoption (RQ1) from a twofold perspective: teachers' needs but also existing barriers. Therefore, RQ1 was furtherly divided in two specific questions: "What are (school and university) teachers' needs for Learning Design tools?"; (2) "What are the main barriers to the adoption of Learning Design tools and the proposed design practices?". This led to identifying categories of factors in both the perspectives. The aim of the review was also seeking to point out research gaps that can motivate why the issue remains unsolved. The systematic literature review analysed the publications in the time frame 2010-2017 and, therefore, it can be considered outdated at the moment of submitting this dissertation, but it reflects the starting point of my thesis work and informed the following phases. The findings of this systematic literature review were presented in one paper published in the British Journal of Educational Technology (Dagnino, Dimitriadis, Pozzi, Asensio-Pérez, Rubia-Avi, 2018). Section 4.5 reports an update of this systematic review including publications from spring 2017 to 2023.

To summarize, through the systematic literature review I was able to collect factors (teachers' needs and barriers) affecting the adoption of Learning Design methods and tools. This first step influenced the decision about the two methods to adopt in the second phase of the research work. The Delphi study was indeed identified as suitable for collecting experts' opinion on the results of the review, to establish the relative importance of the factors identified and to ask experts

about possible solutions to support adoption. On the other hand, the case study was considered a suitable method for analysing the factors in an ecological context and to test possible solutions.

Figure 4.1 shows the flow of the research and the role covered by the systematic literature review in the whole research design. As is represented in the figure, the results nurtured the following actions of the research (case study and Delphi study).

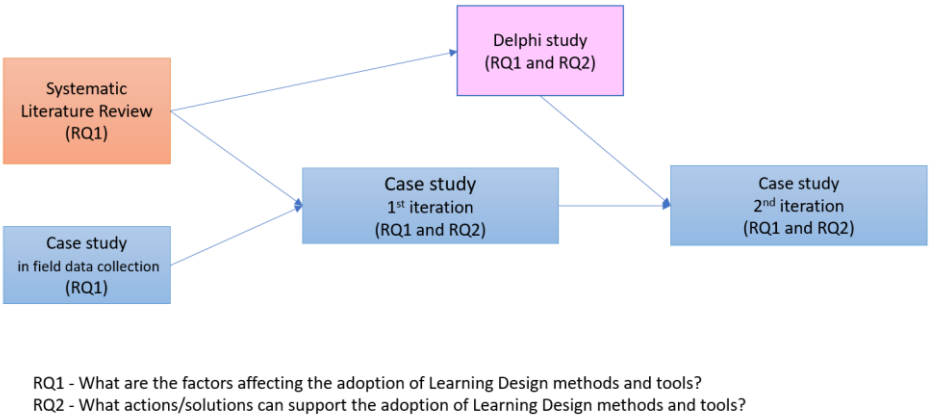

Figure 4.1 - Flow of the research

The following section (4.2) presents the methodology that guided the systematic review. In section 4.3 results are reported organized in two areas: teachers' needs and barriers to adoption. In section 4.4 results will be discussed.

4.2 Methodology

There are several protocols and guidelines that can be followed to carry out systematic literature reviews (e.g., the PRISMA statement, Liberati et al., 2009); this review was carried out following the guidelines proposed by Kitchenham and Charters (2007) for systematic literature reviews. The rationale behind this decision and the details about the guidelines are in section 3.3.1. The systematic literature review was carried out following the phases (planning, conducting, reporting) and the mandatory stages suggested by the authors.

As far as planning, a review protocol was established. As indicated by Kitchenham and Charters (2007), the research questions that guided the review have been stated (see section 4.1).

To conduct the review, five main electronic databases were selected: ACM digital library, IEEE Xplore, Scopus, SpringerLink, and Web of Science. In order to widen the search to a specific type of grey literature - project reports - Google was also consulted.

The search string developed includes the macro research area (learning design or design for learning) and two groups of terms adopted to narrow the search to papers about Learning Design and that consider users (teachers or designers or practitioners). The final search string resulted as follows: ("learning design" OR "design for learning") AND (tool OR "computer system" OR software) AND (teacher* OR designer* OR practitioner*). The string was written according to the format required in the different databases. In most of the databases the search was run considering title, abstract and keywords (except in SpringerLink in which an option including the three fields is not available and, therefore, the search was run over full texts). To narrow the search in terms of time span, the period 2010-2017 was set in the specific field. The search was conducted on April 20th, 2017. A total of 2408 records were retrieved, including journal, conference papers and book chapters.

The records resulting from the search underwent a two-step process. First of all, records retrieved from SpringerLink were selected to reduce the corpus of papers: the string was manually searched in titles, abstracts and keywords. Afterwards, duplicates were removed. After this second step the corpus was reduced to 423 papers. These papers underwent a third step of analysis, titles and abstracts were read to find papers dealing with barriers to adoption of Learning Design methods and tools and teachers' needs. Selection was carried out in relation to the relevance of the contribution to the topics explored and, when they can be inferred, to the inclusion criteria.

The inclusion criteria were the followings:

- Primary study conducting quantitative and/or qualitative research on the topics.
- Language: English.

Twenty-six out of 423 papers were selected for eventual analysis. One more paper cited by Celik and Magoulas (2016b) was also added in the list, since it was clearly of interest. Also, three reports, related to the highly related METIS project (Asensio-Pérez et al., 2014) were considered in the review. The selected works were read by me.

Finally, 20 papers and two reports met the inclusion criteria, providing data about the two research questions (Figure 4.2).

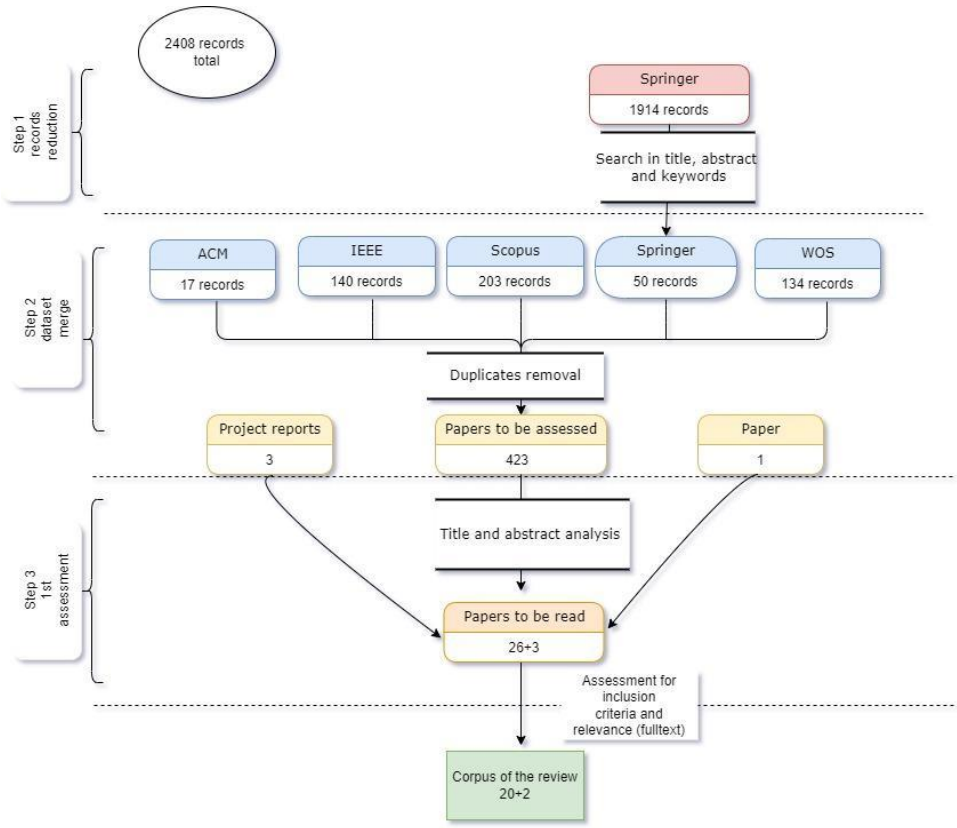

Figure 4.2 - Steps in the selection and analysis of papers (adapted from Dagnino et al., 2018, p.1001)

The methodology adopted for the analysis of the papers was mixed (inductive and deductive). Papers were read and tagged; some key themes were already part of the knowledge pool in the Learning Design field (e.g., the need for flexible tools that can support the preparation of designs suitable for different educational settings or based on different theories of learning) and represented pre-existing categories to tag the documents. Others (e.g., teachers' motivation) emerged from the analysis and were added to the list of themes. As said in section 4.1, barriers to the adoption of Learning Design tools were studied by considering the barriers identified by Ertmer (1999) to the integration of technology in education in general; indeed, the themes that emerged, were organized in light of Ertmer's concep-

tualization of first and second order barriers. The identified barriers will therefore be presented in these two categories.

In the following section I present the results of the analysis of the papers and project reports.

4.3 Results

The list of the 20 papers and two project reports is reported in Table 4.1, together with the context of the study, the participants, the methodology of the study and the aim of the study.

The selected studies have been mainly carried out in Higher Education contexts (with teachers and/or students) or in groups including teachers/practitioners from different contexts (e.g., Higher Education, Adult Education and Vocational Training); this prevented any reflection about specific needs or barriers for specific categories of teachers.

The methods used in carrying out the studies were mainly qualitative or qualitative/quantitative (descriptive statistics like percentages, means, etc.).

The selected studies were focused on one of these three main goals:

- Tools' evaluation: 13 out of the 20 publications focused on the evaluation of a specific tool, mainly in terms of perceived usefulness and/or ease of use. In almost all the studies, evaluation was carried out during the training about the tool or immediately after. None of the studies envisaged a follow up.
- Studies on users' needs: this category includes studies that collect users' needs as a main or secondary outcome (5 out of 20).
- Analysis of design practices: in 3 out of the 20 papers, actual Higher Education (HE) teachers' design practices are explored to identify the desirable characteristics for a Learning Design tool.

Table 4.1 - Papers analysed in the systematic literature review

Authors	*Year*	*Context*	*Participants*	*Methodology*	*Aim*
Arpetti, Baranauskas, & Leo	2013	L2	Teachers	Qualitative	Teachers' design practices
Arpetti, Baranauskas, & Leo	2014a	L2	Teachers	Quantitative	Study on users' needs (teachers' requirements

					for LD tools)
Arpetti, Baranauskas, & Leo	2014b	L2	Teachers	Qualitative/ quantitative	LD tool evaluation
Bennett, Thomas, Agostinho, Lockyer, Jones, & Harper	2011	HE	Teachers	Qualitative	Teachers' design practices
Bennett, Agostinho, & Lockyer	2015	HE	Teachers	Qualitative	Teachers' design practices
Conole, G.	2014	HE	Teachers	Qualitative	LD tool evaluation
Derntl, Neumann, Griffiths, & Oberhuemer	2010	Mixed	Teachers	Qualitative/ quantitative	LD tool evaluation (specifications evaluation)
Derntl, Neumann Griffiths, & Oberhuemer	2012	HE	Teachers	Qualitative/ quantitative	LD tool evaluation (specifications evaluation)
Hermans, Janssen, & Koper	2016	HE	Teachers	Quantitative	LD tool evaluation
Hernández-Leo, Chacón, Prieto, Asensio-Perez, & Derntl	2013	Mixed (AE, HE, VT)	Teachers	Qualitative/ quantitative	Study on users' needs (teachers' requirements for LD tool)
Hernández-Leo, Moreno, Carrió, Chacón-Perez, & Blat	2015	Sec.	Teacher	Quantitative	LD tool evaluation
Katsamani, & Retalis	2013	HE	MSc students	Quantitative	LD tool evaluation
Laurillard, Charlton, Craft, Dimakopoulos, Ljubojevic, Magoulas, … Whittlestone	2013	HE	Practitioners	Qualitative	Study on users' needs

Levy	2015	HE	Teacher	Qualitative	LD tool evaluation
Masterman, & Manton	2011	Mixed	Mixed	Qualitative/ quantitative	LD tool evaluation
Mylonakis, Arapi, Moumoutzis, Christodoulakis, & Ampartzaki	2013	Mixed	Mixed	Qualitative/ quantitative	LD tool evaluation
Papanikolaou, Gouli, Makrh, Sofos, & Tzelepi	2016	HE	Students	Qualitative/ quantitative	LD tool evaluation
Pozzi, Ceregini Persico, Sarti, Brasher, Chacón-Pérez,…Serrano	2015a	Mixed (AE, HE, VT)	Teachers	Mixed methods	LD environment evaluation
Pozzi, Ceregini Persico, Sarti Brasher, Hernández-Leo, & Asensio-Pérez	2015b	Mixed (AE, HE, VT)	Teachers	Mixed methods	LD environment evaluation
Prieto, Asensio-Peréz, Muñoz-Cristobal, Dimitriadis, Jorrin-Abellan, & Gomez-Sanchez	2013	HE	Teachers Students	Qualitative/ quantitative	LD tool evaluation
Prieto Tchounikine, Asensio-Pérez, Sobreira, & Dimitriadis	2014	HE	Teachers	Mixed methods	Teachers' perception of LD tools
Verbert,Ochoa, Derntl, Wolpers, Pardo, & Duval	2012	HE	Teachers	Qualitative/ quantitative	LD tool evaluation

Legend: L2 (Second Language); HE (Higher Education); AE (Adult Education); VT (Vocational Training); Sec. (Secondary school). LD (Learning Design)

4.3.1 Teachers' needs for Learning Design tools

As far as the first issue 'What are (school and university) teachers' needs for Learning Design tools?', the analysis of the literature allowed me to explore or infer teachers' needs even though the main focus of the research reported in the papers was different.

In fact, just in a few cases, researchers directly asked the teachers about their needs, (e.g., Arpetti, Baranauskas, & Leo, 2014a). In other papers, teachers' needs were derived from analysis of the teachers' teaching practices (e.g., Bennett et al., 2015) or from the evaluation of Learning Design tools (e.g., Conole, 2014; Pozzi et al., 2015b).

The categories of needs were developed starting from the analysis of the papers. Hereunder are listed and commented these categories:

1. **Need for flexibility:** in literature, flexibility is considered a key factor for adapting designs to different educational contexts, and it is frequently cited as a desirable feature in a Learning Design tool. In the analysed corpus of papers, flexibility is considered a desirable feature both at tool and method level (Arpetti, Baranauskas, & Leo, 2013) and was cited by teachers as a positive aspect when required to evaluate a Learning Design tool (Conole, 2014). However, the term flexibility is used with different meanings. In some cases, teachers use it referring to theory and context independence. For example, in the process of collecting teachers' requirements for an ideal Learning Design tool, Arpetti et al. (2014a) find flexibility as a central feature for allowing the reuse of designs and their revision and adaptation to educational needs.

   In other cases, the term flexibility is used in relation to the structuring level of the tool and the provided guidance; namely, the more structured a tool is (and the greater the guidance provided), the more constraints are embedded in the design process. Bennett et al. (2015) conducted a series of interviews with university teachers about their design practices, emphasising that a tool should support the design process in a flexible manner but, at the same time, provide guidance. Similarly, Laurillard et al. (2013) and Masterman and Manton (2011) point out that both flexibility and structuring could increase the value of design support tools. In the same vein, Levy (2015) concludes that it is useful to develop design tools that have a high level of flexibility in relation to pedagogical choices. Finally, Prieto et al. (2014) compared teachers' perceptions of two different Learning Design tools (Web Collage and EDIT2) with two different levels of guidance; this comparison did not produce a conclusive position from teachers on this contrast. The need for flexibility was also expressed in terms of facilitating the editing process of projects even when the

teacher is in the delivery phase. This aspect refers to situations where the Learning Design tool is integrated with a delivery environment or, at least, the two systems (design and delivery) are interoperable. In these cases, flexibility refers to the possibility of going back to the original design and modifying it in the light of problems arising during delivery. In particular, Prieto, Asensio-Pérez et al. (2013) report that teachers asked for more flexibility in terms of modifications during delivery; similarly, Hermans, Janssen and Koper (2016) identify as highly desirable the ability to easily switch from the design environment to the delivery environment.

2. **Need for support for teacher cooperation**: this need was mainly deduced from the documents focusing on the evaluation of the tools. According to Papanikolaou, Gouli, Makrh, Sofos, & Tzelepi (2016), the opportunity to receive peer evaluation of a developed project was viewed positively by teachers who participated in the evaluation of the PeerLAND tool. Similarly, researchers of the METIS project found that project participants appreciated the opportunity provided by the adopted Learning Design platform (ILDE) to share their project (e.g., for collaborative small group commenting or editing) (Pozzi et al., 2015b).
3. **Need for support for reuse and adaptation of designs:** this need is mentioned in the papers by Arpetti et al. (2013, 2014a), which gather requirements for the development of Learning Design tools. Laurillard et al. (2013), based on a series of interviews, conclude that, for teachers in higher education, drawing on the work of colleagues is an accepted practice, so a valid learning design environment should support the retrieval of existing designs and their adaptation; of the same opinion are Bennett et al. (2011). Even in works where the focus is on evaluating a tool (e.g., Conole, 2014; Masterman & Manton, 2011), the results indicate that the possibility of reusing and adapting designs developed by others is valued positively when it is available; according to Hernández-Leo et al. (2013), the possibility of (co)creating designs from existing ones is judged useful and this practice seems to be preferred to creating new designs from scratch
4. **Need for support for reflection:** the possibility of designing teaching interventions in a structured manner and having the design itself (in graphic or textual format) available at all times, during and after the design phase, is an important added value of Learning Design. The availability of the design should support reflection on its various aspects (rationale, pedagogical framework, etc.) and rethinking it after its implementation. According to Arpetti et al. (2014a), teachers consider reflection support an important feature of a Learning Design tool. Support for reflection was also explored

by Prieto et al. (2014) and compared with support for practice (i.e., putting ICT-enabled scenarios into practice); in this case, teachers expressed positive opinions regarding support for both pedagogical reflection and concrete teaching practice.

5. **Need for tools easy to be used:** ease of use is one of the most explored aspects with regard to technologies; this aspect is obviously also relevant for Learning Design tools and is cited as a key feature in research (Levy, 2015). In terms of usability, Learning Design tools can be forms that can be easily filled by teachers without specific technical skills, but also tools that require familiarity with Information and Communication Technologies and involve a certain learning curve. The importance of 'usability' was clearly expressed in the user requirements collected by Arpetti et al. (2014a) and is cited among the desirable characteristics of a tool by Bennett et al. (2011). Usability is one of the most commonly assessed parameters in the evaluation studies considered (e.g., Conole, 2014; Hernández-Leo et al., 2015; Katsamani & Retalis, 2013; Mylonakis, Arapi, Moumoutzis, Christodoulakis, & Ampartzaki, 2013).
6. **Need to save time:** in studies investigating needs and requirements, the ability of the tool to save time is mentioned by Arpetti et al. (2014a) as one of the requirements for the use of a Learning Design tools. The same is highlighted in two studies devoted to the evaluation of one or more tools (Hernández-Leo et al., 2015; Prieto et al., 2014) although, in the second case, only implicitly. Furthermore, the study conducted by Verbert et al. (2012) showed that authoring systems that integrate techniques for recommending sequences of activities seem to be preferred to traditional authoring environments (in which the author is free to compose the sequence), as they allow teachers to save time during the authoring process.
7. **Need for support of textual or graphical representation:** different Learning Design tools allow the use of graphical and/or textual design representation. For example, for designing the flow of activities, in the authoring phase, some tools make available a set of icons representing the different kinds of elements (e.g., tasks, resources) that can be combined for building a design (see, for example, CADMOS, Katsamani & Retalis, 2013), others are mainly based on textual representation, having the structure of a template to be filled in (see, for example, EDIT2, Sobreira & Tchounikine, 2012). The issue of type of representation is debated in the field and in the studies analysed teachers express divergent positions about this topic. There are studies in which teachers seem to prefer a textual representation rather than a graphical one. This was found by Arpetti et al. (2013), who report that the representation used to describe the learning design is basically textual and in a following study (Arpetti, Baranauskas, &

Leo, 2014b) that the graphical representation of designs is not valued by teachers. When this aspect is explored during the evaluation of a tool, findings are contradictory: in some cases, teachers seem not to appreciate it (Conole, 2014) while in others the visual metaphor proposed is positively valued (Katsamani & Retails, 2013). According to Masterman & Manton (2011) graphical representation seems to be preferred by teachers at the beginning of the design process.

8. **Need to activate design thinking processes teachers are familiar with:** Laurillard et al. (2013) highlight that, even if the Learning Design tool's ultimate aim should be to enhance teachers' design practice, the tool should mainly support the way teachers approach their normal practice. Bennett et al. (2015), reports that, when designing, university teachers tend to accept support from colleagues of the same subject, especially within the same institution. Starting from Stark's findings (2000), the authors state that the strategy for improving teaching should build on beliefs of faculty groups and derived from the disciplines. In this sense, they state that design support tools should be based on the teachers' and institutional design culture.

4.3.2 Barriers to adoption of Learning Design tools

The second issue that was explored through the review is 'What are the main barriers to the adoption of Learning Design tools and the proposed design practices?'.

In the analysed papers barriers to adoption are rarely openly explored; as said above, the selected studies were mainly about tools' evaluation. Barriers, therefore, are inferred here from teachers' answers and comments. To organise the barriers identified through the analysis, I adopted the framework proposed by Ertmer (1999), who introduced two orders of barriers to technology integration: first-order barriers are defined as extrinsic to teachers and are represented as "*types of resources (e.g., equipment, time, training, support) that are either missing or inadequately provided in teachers' implementation environments*" (p. 50); second-order barriers, on the other hand, are intrinsic individual barriers that are deeply rooted and therefore not so easy to overcome; with second order barriers Ertmer refers, for example, to teachers' beliefs about teaching and learning that may not be immediately evident. As Ertmer himself underlined, and I discuss below, first- and second-order barriers are intertwined.

In the following, the list of barriers belonging to the two categories are presented.

4.3.2.1 First order barriers

1. **Lack of institutional support:** as Masterman & Manton (2011) point out, lack of support hinders the adoption of all technologies in the educational context, and therefore it is also a problem for Learning Design tools. The interoperability between the adopted Learning Design tool and the systems already in use in the institution is an important aspect, since it saves time and money. Pozzi and colleagues (2015a) highlight the technological infrastructure provided by the institutions as another aspect influencing the adoption of a Learning Design tool.
2. **Lack of adequate teacher training:** the integration of new learning design methods and tools entails a change in the usual planning/design practices and in teaching itself; it is evident that this change can hardly take place without specific training. Hernández-Leo et al. (2015) report that half of the teachers involved in their training requested advanced follow-up training sessions to increase their confidence in using the tool. According to Pozzi and colleagues (2015a), participants in the METIS workshops expressed the need for continuous support, especially from a technical point of view.
3. **Time/workload:** time and workload can clearly affect the uptake of innovation in general. Of course, the use of a tool and the related design method can be influenced by teachers' need to save time. Hernández-Leo et al. (2015) as well as Prieto et al. (2014) report that some teachers consider workload and time limits as an obstacle to tool adoption.
4. **Conceptual complexity of method and tools:** the issue of complexity remains controversial in studies. As written in chapter 2, Learning Design tools are very different among themselves, employing very easy templates or even languages developed on purpose (e.g., IMS-LD specifications) that, sometimes, can be considered more complex. Despite these premises, Derntl, Neumann, Griffiths and Oberhuemer (2010, 2012) report that teachers with little or no previous IMS-LD specifications' knowledge were able to solve a design task using the language; therefore, the complexity of the specifications seems not to be an insurmountable barrier to its use for authoring, as is often surmised. Prieto et al. (2014) compared tool perception and adoption intention of a group of teachers exposed to two tools with different levels of complexity. Tool appreciation and adoption intention seemed to be influenced by the order in which teachers were exposed to the tools. Specifically, the teachers who were exposed first to a tool with an easy interface tended to appreciate both tools; on the contrary, the teachers exposed first to the more complex tool expressed less intention to adopt either of the tools after the workshop.

5. **Adoption by peers:** in their research Masterman and Manton (2011), reported that communities of teachers have a pivotal role in supporting the diffusion of a tool. In the same vein, Hernández-Leo et al. (2015), found that the level of participation of colleagues in the community affects teachers' intention to use. Moreover, they identified the degree of adoption by peers as an open challenge.

4.3.2.2 Second-order barriers

1. **Use of Information and Communication Technologies in teaching practice:** this kind of barrier emerged both in the studies of Arpetti et al. (2014a), Prieto Asensio-Pérez et al. (2013) and Prieto et al. (2014). The previous experience in using Information and Communication Technologies in teaching practice seems to have an influence at two levels: 1) It affects the perceived advantage of using the tool (advantages in terms of automatic implementation of the design in the learning management system, where available); and 2) It affects attitudes toward using the tool (participant teachers who did not normally use Information and Communication Technologies in teaching were less likely to adopt authoring Learning Design tools and tended to appreciate tools with an easier interface).
2. **Teachers' motivation:** intrinsic motivation should be considered crucial for the achievement of any type of result and of course also for the uptake of a tool, which should show a clear benefit to the teacher. Institutional imposition, which makes teachers feel their autonomy is limited, can demotivate them (Masterman & Manton 2011). Without speaking explicitly about motivation, Prieto et al. (2014) highlighted that teachers make a cost-benefit analysis when considering usage and adoption of design tools.

4.4 Discussion

This review approached the issue of tools adoption from a twofold perspective: teachers' needs for Learning Design methods and tools and barriers. The studies considered often had aims other than the investigation of these two aspects, therefore needs and barriers have been mainly inferred from teachers' answers or researchers' conclusions. As far as the context of the studies, the majority of them have been carried out in higher education, while a small number present a mixed sample. The prevalence of studies in higher education can be explained considering the growing pressures that teachers in that context are experiencing in terms of quality expectations and introduction of innovations

(Goodyear, 2015). Nevertheless, even at other education levels, innovation in the teaching practice is becoming a major issue and teachers can clearly benefit from a focus on their design practice and needs.

Regarding the teachers' needs, the results confirm that flexibility is a highly desirable quality for a tool. The term flexibility seems to be used with multiple facets (e.g., flexible in relation to the context or pedagogical model, flexible in runtime changes, etc.). Teachers appear to be wary of constraints that tools may impose on the creative process of design, but, in the end, a tool should also scaffold teachers in the design process. This is in line with the results of a research study issued after the review, which had flexibility as one of the main research questions (Pozzi et al., 2020). Teachers seemed to appreciate the flexibility of the tool allowing them to fill in the different fields without forcing a specific sequence or a specific level of detail, but, at the same time, providing guidance to the process. This aspect is intertwined with how the tool aligns with teachers' design thinking, since a flexible tool allows the teacher to follow his/her own design practice.

Ease of use and the capability of a tool to help teachers save time/lower the workload (qualities that can be considered an expression of usefulness or collateral to it) were cited among needs and are, certainly, important for a tool. This opens a due reflection about (a) the importance that perceived usefulness can have in the decision to adopt a tool and (b) the need to provide teachers with the opportunity to familiarize with Learning Design tools (through training or long-term support) in order to appreciate their usefulness.

The possibility to share and reuse one's own designs or designs created by others appear among the needs and are cited among actual design practices; moreover, the possibility to co-create is positively valued when available in the Learning Design tools. Therefore, features supporting collaboration (sharing, reusing and co-creating) seem to be of interest for teachers. The sharing features seem to be particularly appreciated by those working in institutions with a strong collaboration culture (Hernández-Leo et al., 2018).

The issue of the form of representation (graphical or textual) is widely debated in the field and remains controversial also in the literature considered in the review. The preference for textual representation may result from the established practice of teachers to draft their projects in text format on paper, a practice that can easily be reproduced in Learning Design tools based on templates to be filled in. Textual representation may also be considered more readable. Furthermore, tools that propose graphical representations may present a certain complexity: the proposed representations may not be intuitive for teachers and require a non-negligible learning effort. A possible solution proposed by Pozzi et al. (2020) is to integrate both forms of representation in the tool, favouring graphical forms well

known by teachers, such as mind maps, instead of providing original but 'proprietary' forms of representation.

Regarding the barriers to adoption, papers were analysed in the light of Ertmer's (1999) organization in first and second order barriers. Among the first order barriers, the context (that can be the institution or the professional community) seems to have a role in adoption and is an aspect that needs to be considered. As far as the role of the institution, if top-down impositions can be ineffective or counterproductive (Masterman & Manton, 2011), the lack of support from the institution can be considered a barrier to adoption (Pozzi, 2015a). On the other hand, the presence of an active community of peers seems to positively affect adoption intentions.

Adequate training seems to be another crucial aspect, which can also entail the creation of a community in which teachers share Learning Design experiences and designs, as proposed by Asensio-Pérez and colleagues (2014).

The conceptual complexity of methods and tools has been considered one of the aspects hindering the adoption; the results reported in some papers analysed in this review seem not to confirm this assumption. However, it is worth noting that two of the studies (Derntl et al., 2010; Derntl et al., 2012) are focused on the IMS-LD specification, which represents a specific case that cannot be generalized. Moreover, the studies refer to the learnability of the IMS-LD specifications and not to the teachers' intention to adopt them. Time and workload can be considered transversal factors and are symmetrical to the need to save time. Unfortunately, in several educational contexts the time devoted to the design of the learning experience is not acknowledged, neither in terms of workload nor of salary. For this reason, the issue of time saving might be felt as prominent.

As second order barriers, I identified two main issues in the analysed papers: the use of Information and Communication Technologies in teaching practice and, last but not least, motivation. Motivation is scarcely explored in the analysed literature, suggesting that it might deserve more attention and more thorough analysis.

The panorama of needs and barriers outlined in this review reflects a complexity of partially interrelated aspects. Some barriers can be seen as symmetrical to needs, for example the issue of tool complexity is symmetrical to the need of tools ease to use. Similarly, the social/community aspect is expressed both as a need and a barrier: teachers require (or evaluate positively) tools supporting collaboration with others and the lack of support of the community is seen as an obstacle to adoption. If I revisit the analysis of Asensio-Pérez et al. (2017) presented in the introduction, some of the elements listed in this review can be included in the three main categories of factors affecting adoption proposed (features of Learning Design tools, teachers' mindset and training). However, according to my analysis, other elements such as contextual and individual fac-

tors, were not included or at least remain overshadowed in that categorization but appear to unite Learning Design tools with technologies in general.

The findings from this literature review did not break new ground per se since most of the issues presented are well known in the research field. The aim of this review in the flow of the thesis lies in the systematization of these findings, so as to have a set of elements to investigate in the following actions of the research.

Moreover, the review highlighted some gaps in the available literature needing to be thoroughly deepened by researchers in the field. Firstly, even though teachers are the final users of the proposed methods and tools, few of the studies selected for this review directly explore teachers' actual design practices and needs. The reason may lie in the propensity to conduct research relating to the specific field of interest of researchers and not merely exploratory. On the one hand, researchers with a technological background tend to focus more on the usability of specific tools, leaving educational aspects in the background. On the other hand, researchers with an educational background do indeed pay more attention to the current needs and practices of teachers but are more interested in exploring the effectiveness of their proposal for Learning Design. Therefore, in both cases, the studies remain focused on specific methods and tools and rarely investigate the topic itself.

The lack of studies specifically dedicated to barrier analysis can be considered a gap in the field. Despite the attention devoted to the issue of tool adoption, just one paper (Prieto et al., 2014) explored perceived barriers to adoption directly with teachers/practitioners themselves, while the others mainly focus on the evaluation of specific tools. This often led to results, and actions, related to specific tools or situations, narrowing the impact of the research.

Almost none of the studies included in the review adopts a comparative approach, which in fact could be productive for identifying the perceived strengths and weaknesses of different tools and methods in the eyes of teachers. Here again, the reason may be the primary need to evaluate the effectiveness of the proposed methods and tools, overshadowing the general issue of adoption.

In addition, the adoption of a new practice or a tool is a complex process that should be monitored in the long term but, probably due to various constraints in terms of time, cost, teacher availability, etc., almost no studies envisaged a follow-up: while teachers are asked about their experience with a tool or method immediately after a course or a practice experience, a follow-up aimed at understanding whether the experience had an impact and led to concrete adoption is quite uncommon. A final reason could be a generally pessimistic view of teachers' ability to work as designers in their own right.

Furthermore, few of the studies reviewed explored barriers at the individual level and, in particular, the aspect of motivation, which could be relevant to the

design and implementation of actions to promote the adoption of tools and methods.

As far as the research community, some recommendations can be derived from this analysis of the literature. First of all, current research on Learning Design for the introduction of a more design-based approach into teaching practices should be balanced with complementary studies aimed at better understanding current teaching practices and beliefs (see, for example, Bennett et al., 2015, 2017). This could help develop artefacts that can guide the design process and, at the same time, improve it, striking a balance between actual and optimal practices (Laurillard et al., 2013). This aspect could also be explored in relation to teachers' motivation to adopt Learning Design methods and tools.

Since the focus on tools usability may distract the attention away from factors that are 'tool-independent', research effort should be dedicated to exploring transversal barriers, to reach more general conclusions and address them effectively. Broadening of focus, especially in the direction of individual/personal factors would follow the path indicated by Straub (2009). Summarising the main theories in the field of technology adoption and diffusion, Straub concludes that technology adoption is a process that is complex, inherently social and developmental in which the characteristics of the innovation are only one of the factors influencing its adoption; according to Straub, individual and contextual factors also play an important role. In this sense, addressing cognitive, affective and contextual aspects becomes crucial to support adoption, and these should be studied.

Another point is the importance of comparative studies. Studies like the one proposed by Prieto et al. (2014), can support reflection on desirable features of tools and possible solutions to foster teachers' adoption of Learning Design tools and methods. These comparative studies should not be limited to an experimentally designed phase (within a controlled context such as a workshop or seminar) but should also include a follow-up phase in which teachers' opinions (or behaviours) are investigated again after that they used the tools in their own teaching contexts, in authentic conditions. This kind of studies could provide researchers with interesting data, because only by testing and comparing different solutions can teachers express their preferences and really become aware of their needs in terms of features offered. Comparative studies could benefit from collaboration between institutions that have developed Learning Design methods and tools and that are currently carrying out training initiatives with teachers.

Finally, conducting more follow-up or long-term studies that involve teachers who have used or been trained with one or more Learning Design tools could shed light on the factors influencing the decision to adopt a method and/or design tool. Indeed, these teachers could be considered as informants and contribute to research in the field. Of course, these kinds of studies require considerable investment and suffer from the drop-out of participants in the long run, but never-

theless they seem to me to be the way to go to gather meaningful information. For follow-up studies, the creation of online communities and the provision of long-term support by trainers can increase the opportunities for data collection.

Finally, I drew some conclusions from the methodological viewpoint, especially about the advantages and implications of the use of digital technologies to support data collection and analysis in the systematic literature review; these conclusions were published in a paper dedicated to the research design of the thesis (Dagnino et al., 2020). For retrieving the papers, I consulted five electronic databases that, according to the definition of Hai-Jew (2015), represent secondary information collection tools. The use of electronic databases allowed me getting reliable results, by finding papers corresponding to my interests in a large amount of literature through a fast and accurate automatic selection process; on the other hand, the search required to develop a search string which allowed me to include only publications of interest without excluding any. This was the most challenging issue since an inaccurate or broad search string could have significantly affected the conclusions of my research. For managing the search results, I relied on Excel, which was used for abstract and title analysis, supporting the selection process aimed at reducing the number of relevant papers. Excel is a well-known and easy to use software, but its use in this case required 'soft' technical capabilities since it was necessary to write a script for merging the different datasets; in this case I had to ask for help. Therefore, conducting the systematic literature with the support of available digital technology has led me to acquire new skills and collaborate with other researchers to minimize possible mistakes.

4.5 Review update

Since the systematic literature review considered the literature between 2010 and 2017, I carried out a new search in May 2023 (covering the time frame April 2017-April 2023), using the same search string, only on one database (Web of Science) to study the advancements in the research as far as the adoption of Learning Design tools and methods. Web of Science covers a wide range of publications in Social Science and Technology, but it is more selective than Scopus (Singh, Singh, Karmakar, Leta, & Mayr, 2021).

A total of 110 records were retrieved, including journal, conference papers and book chapters. The same procedure applied in the systematic literature review was adopted to select the papers to read. Twenty out of 110 papers were selected and read by me. Thirteen papers were considered for this update and are reported in Table 4.2.

The selected studies were carried out in multiple contexts (Teacher Education, School and Higher Education) and most of them (9) used both qualitative and quantitative methods or mixed methods.

As far as the aims of the studies two main aims were identified:

- Tools' perception/evaluation: eight out of the 13 papers focus on the evaluation of a specific tool, mainly in terms of perceived usefulness and/or ease of use but also about specific research questions (e.g., Zalavra & Papanikolaou, 2019).
- Studies on users' needs: this category includes studies that collect users' needs as a main or secondary outcome (4 out of 13).

As detected in the systematic literature review, the evaluation was carried out mainly during the training about the tool or immediately after. In some cases, tools were presented in training courses and teachers had months to use the tool(s) (see for example studies conducted by Zalavra & Papanikolaou (2019), Zalavra, Papanikolaou, Dimitriadis, & Sgouropoulou (2021) and Zalavra, Papanikolaou, Dimitriadis, Sgouropoulou (2023)). Kurvits et al. (2019) reported that teachers had used the tool for 4 months before the assessment. None of the studies envisaged a follow up.

The study not included in the two groups had the declared aim to identify the design principles for developing a tool (ed-Crumble) (Albó & Hernández-Leo, 2018) by exploring the design practices of the involved teachers.

Table 4.2 - Papers analysed in the review update

Authors	*Year*	*Context*	*Participants*	*Methodology*	*Aim*
Albó, & Hernández-Leo	2018	Sec.	Teachers	Qualitative	Extract design principles
Albó, & Hernández-Leo	2019	Sec.	Teachers	Mixed methods	Tool perception/evaluation
Albó, & Hernández-Leo	2021	Mixed	Teachers	Qualitative/ Quantitative	Tool perception/evaluation
Bakki, & Oubahssi	2021	NS	NS	Quantitative	Tool perception/evaluation
Bakki, & Oubahssi	2022	NS	NS	Quantitative	Tool perception/evaluation
Divjak, Grabar, Svetec, & Vondra	2022	HE	Practitioners	NS	Tool perception/evaluation

Kurvits, Laanpere, Väljataga, & Robtsenkov	2019	NS	Teachers and educational technologists	Qualitative/ Quantitative	Tool perception/ evaluation and development
Laurillard, Kennedy, Charlton, Wild, & Dimakopoulos	2018	NS	Teachers	Qualitative/ Quantitative	Tool evaluation
Pozzi, Asensio-Pérez, Ceregini, Dagnino, Dimitriadis, & Earp	2020	Prim. and Sec.	Teachers	Qualitative/ Quantitative	Teachers' needs
Schmitz, Scheffel, van Limbeek, Bemelmans, & Drachsler	2018	HE	Teachers and students	Qualitative/ Quantitative	Teachers and students' needs
Zalavra & Papanikolaou	2019	TE	Pre-service teachers	Qualitative/ Quantitative	Tool perception/evaluation
Zalavra, Papanikolaou, Dimitriadis, & Sgouropoulou	2021	TE	Pre-service and in service teachers	Mixed methods	Teachers' needs
Zalavra, Papanikolaou, Dimitriadis, & Sgouropoulou	2023	TE	Teachers	Mixed methods	Teachers' needs

Legend: TE (Teacher Education); HE (Higher Education); Prim. (Primary school); Sec. (Secondary school); NS (Not Specified).

For this update, the needs and barriers identified in the systematic review were searched in the documents, but, as in the first review, a double approach (inductive and deductive) was adopted so as to identify new ones.

4.5.1 Teachers' needs for Learning Design tools

Regarding the factors identified in the systematic literature review, the results of the papers analysing teachers' needs partially overlap with the previous findings.

1. **Need for flexibility:** this need is reported in several of the studies, in terms of theory and context independence or level of guidance. Zalavra and Papanikolaou (2019) point out that teachers suggested to make the pre-defined options given by the tool extendable and customizable while Divjak, Grabar, Svetec, Vondra (2022) report the teachers' request to make the tool independent from the formal study programme. Other authors explored the possibility to let the user select the level of guidance provided by the tool (Pozzi et al., 2020; Zalavra, et al. 2021), indeed the preference for guidance or support remains debated (Zalavra et al., 2023) and the solution to increase the freedom of the user to decide the level of guidance within the tool can be valuable. The issue of flexibility was explored also by Albó and Hernández-Leo (2019) and Laurillard, Kennedy, Charlton, Wild and Dimakopoulos (2018).
2. **Need for support for teacher cooperation:** it is mentioned in several papers (Albó & Hernández-Leo (2018, 2021), Kurvits et al. (2019), Laurillard, et al. (2018) and Zalavra & Papanikolaou (2019)). Albó and Hernández-Leo in the paper published in 2021 highlight the teachers' need to increase cooperation within and outside their community (institution). For assuring this support, social features have been integrated in their tools by Kurvits and colleagues in the tool Le Planner, and Albó and Hernández-Leo in edCrumble. Laurillard et al. (2018), pinpoint that Learning Designer was able to build and support an international community of teachers developing and sharing their designs.
3. **Need for support to reuse and adaptation:** the need is cited by Albó and Hernández-Leo (2021) who highlight the fact that edCrumble is built on top of the LdShake platform (for sharing learning designs) and therefore supports reuse and adaptation. Kurvits et al. (2019) report that teachers require the possibility to reuse other teachers' designs.
4. **Need for support for reflection:** this aspect was explicitly investigated by Zalavra and Papanikolaou (2019) and Albó and Hernández-Leo (2021) in relation to specific tools: Learning Designer and edCrumble. According to the authors, the design analytics provided by both the tools were appreciated by teachers since they support their reflection on designs. Moreover, Zalavra and Papanikolaou (2019) state that teachers asked for more feedback on the designs to support reflection. Finally, Laurillard et al. (2018) report teachers' feedback on the capability of the tool to support reflection.
5. **Need for tools easy to be used:** the usability of the tool was investigated by Albó and Hernández-Leo (2021), Bakki and Oubahssi (2021, 2022), Laurillard et al. (2018) and Zalavra and Papanikolaou (2019).

6. **Need to save time:** Kurvits et al. (2019) report that teachers considered the tool (LePlanner) able to help them save time without further specifications. Albó and Hernández-Leo (2021) state that the possibility to share designs and reuse those prepared by others would save time. Nevertheless, teachers involved in the evaluation did not confirm this statement.
7. **Need for support of textual or graphical representation:** this issue is deepened in three studies with completely different objectives. While Kurvits et al. (2019) conclude that the visual representation should be preferred to narrative representation to support teachers in changing their teaching approach, Pozzi et al. (2020) analyse the issue in the different phases of a design and conclude that a tool integrating the two different forms of representation allows teachers to make the most of them and follow the specific needs. In the other study, thanks to a comparative approach, Zalavra et al. (2023) analyse different dimensions of the graphical representation and conclude that teachers prefer a visual format and a global organisation. Also, Laurillard et al. (2018) report teachers' appreciation for the visual representation provided by the tool.
8. **Need to activate design thinking processes teachers are familiar with:** three papers report participatory design approaches for the design of Learning Design tools. In two cases authors followed a process of co-design of the tool with teachers (Albó & Hernández-Leo, 2018; Kurvits et al., 2019). In the other paper, authors report to have collected needs preliminarily (Schmitz, et al. 2018). This need may refer more in general to teachers' existing design practices. For example, Albó and Hernández-Leo (2018) developed design principles for their tool (edCrumble) and conclude that the tool can be based on an activity-centred model but, at the same time, it should allow teachers to connect with their content-based approach. Moreover, they highlight that the tool should be based on a timeline where users can place their activities sequenced, since this is the way in which teachers are used to plan their activities. For the same reason, Kurvits et al. (2019) similarly conclude that the design (defined pedagogical scenario) should be presented on a timeline.

Other needs emerged in this update are:

9. **Need for support to deployment:** the issue of the implementation of the designs in learning management systems was central in the field; indeed, the integration would allow teachers to save time in the course implementation and to collect information in order to reflect on the design in the light of its implementation. In the previous literature review this issue did not emerge but was cited by experts in the Delphi study (see section 5.3.3). In this update it is reported as a need expressed by teachers to in-

crease the usefulness of the learning design environment (Divjak, et al. 2022; Zalavra & Papanikolaou, 2019), and as a recommendation of authors to make the tool useful in different contexts (Pozzi et al., 2020). Integration/coherence between the two tools was also tackled from a completely different perspective, namely having the learning management system as the focus and conceiving the Learning Designs tool as a support to MOOC design (see Bakki & Oubahssi, 2021, 2022 who developed a design tool to support the course design in Moodle).

10. **Need for support of learning analytics:** the attention towards analytics has grown in the last years as highlighted in section 2.4.1. Indeed, analytics can inform the decisions about designs and contribute to their evaluation (Pishtari et al., 2020). Among the papers analysed, Schmitz et al. (2018) specifically investigated the needs of teachers and students for a dashboard, to personalise feedback on learning activities. Learning analytics are cited also by experts in the Delphi study (see section 5.3.3).
11. **Need for support to conceptualization of learning designs:** two studies about the tool Learning Designer highlight teachers' appreciation of the pedagogical support given from the tool (Laurillard et al. (2018) and Zalavra & Papanikolaou (2019)). The same appreciation was obtained by Albó and Hernández-Leo (2021) regarding the edCrumble tool. This need is intertwined with the need for guidance discussed before and emerged also in the Delphi study (see section 5.3.3).
12. **Need for sharing (part of) the design with students:** some of the studies analysed highlight teachers' attention towards sharing designs or plans with students. In the development and evaluation of edCrumble Albó and Hernández-Leo report the teachers request (2019) and the positive evaluation (2021) of the possibility to share the plan with students. Kurvits et al. (2019) moved a step forward and propose the possibility to co-design with students.

4.5.2 Barriers to adoption of Learning Design tools

Barriers were openly investigated only by Albó and Hernández-Leo (2021), using the initial systematic literature review (Dagnino et al., 2018) as a reference. Barriers in other studies were, as I have done in the systematic literature review, inferred by teachers' answers and comments.

4.5.2.1 First order barriers

1. **Lack of institutional support:** this factor was investigated with teachers by Albó and Hernández-Leo (2021) but in terms of 'institutional recognition'. Using this specific interpretation, teachers' answers diverged, and half of the respondents considered it not important. On the other hand, institutional support can take different forms (like dedicated time to design or an adequate infrastructure), therefore this barrier needs to be studied considering the different forms the institutional support can take. Indeed, the same authors refer that one barrier identified by the teachers is the 'lack of systematics', that could be addressed at institutional level by providing more support to teachers and reaching agreement with teachers on the introduction of new ways of working.
2. **Lack of adequate teacher training:** this barrier can be found only in Albó and Hernández-Leo (2019) in terms of the need for support to learn how to use the tool expressed by one teacher.
3. **Time/workload:** the issue of time resulted from some of the considered studies, for example Albó and Hernández-Leo while defining the design principles of edCrumble; the same authors in 2019 reported that teachers identify as a weakness of the tool (edCrumble) the high investment in terms of time required to create a complete design, a similar consideration was reported in the study for evaluating the tool in 2021. The issue of teachers' limited time for designing learning is reported also by Laurillard et al. (2018) even though it was a single teacher who raised it. Kurvits et al. (2019) cited the lack of time among the difficulties met by teachers.

Two other first order (extrinsic) barriers identified in the systematic literature are not present in the selected papers: 4. **Conceptual complexity of methods and tools** and 5. **Lack of adoption by peers**. As far as the issue of the complexity, it could be because the usability was a concern shared by many of the authors. Two more extrinsic barriers emerged from this update:

6. **Scarce adaptability of tools to context/curriculum:** this barrier was suggested by experts in the Delphi study (see section 5.3.3). Zalavra and Papanikolaou (2019) report that some of the teachers felt limited by the tool and would have preferred to parametrize it, adding alternatives to those proposed by the tool.
7. **Scarce maturity of the tools:** Albó and Hernández-Leo (2019) cite among the weaknesses of the tool the fact that the tool still had usability issues and lacked functionalities to be implemented.

4.5.2.2 Second order barriers

The systematic literature review identified two second order barriers. The 1. **Use of Information and Communication Technologies in teaching practice** does not appear in any of the studies. The 2. **Teachers' motivation** was not openly explored in the papers, but Albó and Hernández-Leo (2021) report that teachers' perception of an imbalance between costs and benefits to the detriment of the latter is an obstacle to adoption.

4.5.3 Discussion

This update has the aim of providing an overview in the advancements of the literature about the adoption of Learning Design methods and tools.

Analysing the studies in the light of the points raised in the systematic literature review, an interesting finding is that Albó and Hernández-Leo, for the first time, approached the development (2018) and the evaluation of a tool (2021) with a clear focus on adoption. In their paper published in 2018 they identified two rules which they think can facilitate the adoption of the Learning Design tools in the educators' daily practice: 1) tools should seek to connect with teachers' existing practices and 2) tools should seek for solving teachers' day-to-day problems. In 2021, they extended the tool (edCrumble) evaluation to the analysis of the factors affecting adoption taking into consideration the results of the previous literature review (Dagnino et al., 2018). Moreover, among the selected studies it is possible to find a comparative study conducted by Zalavra et al. (2023) on the form of representation of designs in Learning Design tools. The conduction of comparative studies was advocated in the systematic literature review since it can support reflection on desirable features of tools and possible solutions to foster teachers' adoption of Learning Design methods and tools.

Considering the two categories of factors (needs and barriers), it is evident that the selected studies put greater attention on teachers' existing practices and their needs than on difficulties met by teachers in using the tools, let alone in their adoption. This makes me conclude that barriers remain an underestimated issue in spite of the conclusions I reached with the systematic literature review (Dagnino et al., 2018).

In this update I traced the needs and barriers identified in the first systematic review, but I also found new ones. Speaking of needs, the update of the review shows an overlap with the original systematic review, but additional ones were retrieved. These needs indicate a focus on the enactment of the designs with students as they relate to designs deployment through learning management systems and learning analytics, a source of information for the teachers.

Regarding barriers, as said above, a limited attention was devoted to them. Nevertheless I traced some of the barriers identified in the systematic literature review (such as time/workload and the institutional support) and found new ones: the first is related to the adaptability of the tool to different contexts (that can be related with the need of flexibility expressed by teachers): when a tool is not pedagogically neutral it can run the risk to be considered scarcely adaptable; on the other hand it provides a specific pedagogical support. The other is related to the maturity of the tools; tools at their very early stages can be perceived as less usable by teachers.

4.6 Conclusions

This chapter includes the systematic literature review that was the starting point of my research, and its update that I carried out after the conclusion of the thesis work in 2023. This update has the aim of providing the current state of art.

The systematic literature review carried out in 2017 helped me identify a list of needs and barriers and directed me towards the further steps of the thesis work. First of all, since it was not possible to establish a level of importance of these needs and barriers this question required to be further explored. Obviously, it could be explored in a real-life context with end-users of Learning Design methods and tools, but I also thought that asking experts to express their opinions on these findings through a Delphi study could bring interesting progress in the field. Furthermore, it was thought that the Delphi study (that is described in chapter 5) could be useful to involve experts in suggesting possible solutions to meet teachers' needs and overcome barriers, solutions that could be tested in a real context (the case study).

Instead of multiple short-term studies, these results directed the research towards a case study that could be the setting for a long-term study and where some solutions could be tested. Although multiple short-term studies could have provided different perspectives, the literature review supported the idea that the adoption process should be studied in the long term. The case study aimed at this goal will be described in chapter 6.

The update of the literature review confirmed the trend of carrying out studies covering the training but not the following periods and the actual use of the tools. The issue of adoption was openly discussed only in a couple of studies carried out by the same authors. The lack of long-term studies focusing on adoption confirms the informative potential of this thesis.

Chapter 5
Delphi study

This chapter reports the design, implementation and results of the Delphi study. The Delphi study was held in the second phase of the research study to answer RQ1 and, partly, RQ2, namely, to study the factors affecting the adoption of Learning Design methods and tools and to identify possible solutions to overcome the barriers to adoption. The Delphi study is based on the findings of the systematic literature review reported in chapter 4; the review allowed to identify teachers' needs and barriers, but it was not suggestive of their relative importance and therefore of what aspects may have a greater impact on adoption and, then, deserve more attention by researchers. For this reason, needs and barriers that emerged from the review were presented to a panel of experts who were asked to (i) rate the relative importance of these factors (teachers' needs, extrinsic barriers, intrinsic barriers) and (ii) provide their opinions about how these may affect the adoption of Learning Design methods and tools. Finally, experts were also asked to suggest possible solutions to increase adoption, in the light of the reflections triggered in the Delphi study. Experts did not identify one of the two categories of factors as prevalent but agreed that they are almost equally important; on the other hand, they also agreed that needs deserve more attention when studying the adoption of Learning Design methods and tools. As far as the specific needs, experts gave a higher rate to those related to the teachers' need to optimize their work in terms of time and effort, like for example the ease of use of the tool or its capability to help save time. Among barriers experts rated more contextual and transversal barriers such as time/workload or lack of institutional support. Regarding suggestions, experts focused mostly on solutions to overcome these last barriers, like the support of the institution or the lack of teachers' training, even though particular attention was also paid on the maturity of the existing tools.

5.1 Introduction

The Delphi study was conducted to further advance the systematic literature review (see chapter 4). The review explored the actual needs of teachers as far as Learning Design in terms of methods and tool features, and also the barriers preventing Learning Design adoption. In the review, teachers' needs were presented and discussed as a single category, while barriers were classified according to Ertmer's (1999) categorization of barriers to technology integration, namely two orders of barriers: (a) first order barriers are defined as extrinsic to teachers and are represented by "*types of resources (e.g., equipment, time, training, support) that are either missing or inadequately provided in teachers' implementation environments*" (p. 50); (b) second order barriers are intrinsic individual barriers, deeply ingrained and therefore not so easy to overcome.

The systematic literature review explored needs and barriers but did not allow me to reach conclusions about the importance of these categories in affecting adoption, as well as the importance of the single needs and barriers emerging from the review. Therefore, the Delphi study is aimed to address these issues, in particular:

- To define the relative importance of three categories of factors (teachers' needs, extrinsic barriers, intrinsic barriers) with respect to the adoption of Learning Design methods and tools.
- To define the relative importance of a set of needs and barriers, according to their perceived level of influence in the adoption of Learning Design methods and tools.

Finally, experts were asked to suggest possible solutions to increase adoption, starting with the factors they identified as most impactful.

The flow of the research and the role covered by Delphi study in the whole research design is shown in Figure 4.1.

As it is represented, the Delphi study was nurtured by the systematic literature review and contributed to the second iteration of the case study. Indeed, in the second iteration of the case study I investigated both the factors emerged from the systematic literature review and the Delphi study, and some of the solutions proposed by the experts in the Delphi study were tested with teachers.

The decision to use the specific method of Delphi study was explained in section 3.3.2; in brief the Delphi study was identified since I was interested in collecting the opinions of experts in the Learning Design field (and reach consensus among them, as much as possible) on the factors identified, by taking advantage of the benefits of using a group technique but limiting the disadvantages of direct confrontation which can inhibit the expression of different opinions. The Delphi method is described in section 3.3.2.

5.2 Methodology

5.2.1 Procedure

The Delphi study was carried out according to the model proposed by Custer et al. (1999); their modified Delphi study model suggests the use of a set of carefully selected items proposed by the researcher, instead of open-ended questions in the first round. In this case the items of the questionnaires were based on the results (the needs and barriers) of the systematic literature review. Therefore, they included eight needs: 1) Flexibility; 2) Support for reuse and adaptation of designs; 3) Support for co-operation among teachers; 4) Support for reflection; 5) Ease of use; 6) Time saving; 7) Textual and/or graphical representation; 8) Coherence with the teachers' design thinking and culture. Regarding the barriers, as said above I adopted the categorization proposed by Ertmer (1999): first and second order barriers. As to first order barriers, the following five barriers were included: 1) Lack of institutional support; 2) Lack of adequate teacher training; 3) Time/workload factors; 4) Conceptual complexity of methods and tools; 5) Adoption by peers. For the second order barriers, two main barriers were included: 1) Lack of use of Information and Communication Technologies (ICTs) in the teaching practice and 2) Lack of motivation.

Experts' opinions were gathered through online questionnaires (available in Appendix 1. Data collection tools); indeed, experts were invited to rate the needs and barriers listed above. In the first round, experts were also required to propose needs and barriers they thought should be included while in the second-round experts were required also to suggest possible solutions.

Questionnaires were structured into both closed and open-ended questions (to motivate the given ratings), and they will be described in detail in the sections below.

5.2.1.1 Round I

The questionnaire for the first round included 11 questions which were organized in five clusters:

- Consent form (2 questions).
- Background information (2 questions).
- Part A: relative importance of the categories of factors that have been explored in the literature review (teachers' needs, extrinsic and intrinsic barriers) (2 questions).

- Part B: influence of specific teachers' needs and (extrinsic and intrinsic) barriers in Learning Design adoption (4 questions).
- Comments on the study (1 question).

In Part A, participants were asked to rank the three categories in order of importance and to motivate their rankings (open ended question). In Part B, participants were required to rate how much, in their view, a list of specific needs and extrinsic/intrinsic barriers affect Learning Design adoption by teachers; this was done on a five-point scale ranging from 1 (Not at all) to 5 (Extremely); the list of needs comprised eight items while the list of barriers comprised seven items (five extrinsic and two intrinsic). Moreover, the experts could add any other needs or barriers they felt were missing from the proposed list (open-ended questions).

5.2.1.2 Round II

At the beginning of the second-round respondents were given feedback on the first-round results through a summary report (see Appendix 2. Results). After the first round I had the impression (based on the motivations participants expressed regarding their rankings) that the description of the provided categories of factors might have been misleading, especially regarding teachers' needs. Therefore, a new, more extended description was provided in the report, so as to avoid misunderstandings during the second round. In Part A experts were required to rank again the three categories of factors and to motivate their ranking, as in the first round. In addition, they were asked to indicate what categories research should pay more attention to in the future. In Part B they rated again the needs and barriers of the first round. Moreover, they were required to rate, on the same scale (from 1 (Not at all) to 5 (Extremely)), the needs and barriers suggested by others in the first round. The list of needs was increased by 9 items derived from the first round of the Delphi study (17 in total); the list of barriers was increased by 6 others derived from the first-round answers (13 in total). Finally, participants were invited to suggest possible solutions to the listed barriers (open ended question).

5.2.2 Panel selection

As described in section 3.3.2, the panel of the Delphi study needed to be composed of a selected group of experts with a high level of expertise in the topic (Ziglio, 1996); the composition of the panel should be heterogeneous (Rowe and Wright, 2001). In this case, according to Falconer, Finlay and Fincher (2011) Learning Design research typically assumes two main perspectives: some studies are more technology-oriented, whose focus is on the development of digital sys-

tems that help to orchestrate the delivery of learning resources and activities for computer-assisted learning; others are more pedagogy-oriented, and focus on finding effective ways to share innovation in Technology Enhanced Learning practice. In order to ensure the presence of both perspectives and the heterogeneity of the panel, I recruited experts from both the education and the engineering / computer science domains.

To this aim, 36 experts were initially listed; they were researchers in the field of Learning Design who had authored publications in peer-reviewed journals on the topic and who were active members in the Learning Design community. These experts were contacted via email and informed about the objectives of the study and the expected commitment. This initial cohort included 28 experts with a background mainly in education and eight in engineering / computer science. Twenty-four of the experts were affiliated to European institutions (universities or research centres), reflecting the largely European origins and geographic scope of Learning Design research. In the end, 25 experts agreed to participate.

The 25 experts who agreed to participate received an invitation to fill in an online questionnaire administered through an open-source survey application (Limesurvey).

All experts were assured anonymity and confidentiality and signed a consent form (see Appendix 1. Data collection tools).

5.2.3 Data analysis

Data were analysed following a convergent strategy of mixed methods (Creswell, 2014), therefore both quantitative and qualitative analyses were carried out on the data collected:

- Closed questions: descriptive and inferential statistics were calculated. Data about the ranking of the three categories of factors (Part A of the questionnaires) were analysed using the Friedman test (Friedman, 1940). Consensus among the experts and stability of the experts' opinion were calculated using InterQuartile Range (IQR) and Wilcoxon test as suggested by von der Gracht (2012). Variance homogeneity in the two rounds was also calculated, to evaluate if the dispersion of the answers remained stable. Finally, regarding the needs and barriers suggested by the experts, the difference between the mean of respondents' answers and the midpoint of the scale was calculated (Wilcoxon signed rank test), so as to identify those that gained a significantly higher evaluation than the ex-

pected value (3) in terms of impact. These statistics were calculated using R^2, that is a language and environment for statistical computing.

- Open-ended questions: two independent coders processed them. Categories were derived from the emergent data using an inductive approach. A recursive, step-by-step procedure was adopted (Mayring, 2000) in which the two coders independently identified the codes and then discussed them until an agreement was reached.

Theoretical premises (a solid literature review as indicated by Iqbal & Pipon-Young, 2009) and the results of the data analysis led me to run only two rounds.

5.3 Results

5.3.1 Participants (background information)

Twenty out of 25 invitees filled in the questionnaire (overall response rate 80%) in the first round. Eleven have a background in education, four in engineering or computer science, and five work in both fields. Most of the respondents are based in Europe (15 out of 20). All the experts had at least five years' experience in the field.

Eighteen out of 20 experts participated in the second round (overall response rate 90%). Nine have a background in education, four in engineering or computer science, and five in both fields.

5.3.2 Ranking of the three categories of factors

In both rounds experts were required to rank the importance of the three categories of factors, teachers' needs and perceived barriers (extrinsic and intrinsic), in understanding the issue of adoption of Learning Design methods and tools.

In the first round (Figure 5.1) experts' opinions seem to converge as for 'Extrinsic barriers' (ranked mainly in the first two positions) and 'Intrinsic barriers' (almost equally ranked in second and third places), while opinions are polarized as to 'Teachers' needs' (mainly ranked in first and third places).

In the second round (Figure 5.2), after the feedback on the first round and the provision of more detailed explanations of the factor categories, answers' distribution shows a shifting towards consensus (intended as the agreement of the majority of the respondents) for 'Intrinsic barriers', while the experts' position re-

[2] https://www.r-project.org/

main polarized for ‘Teachers’ needs’. In this second round, experts’ opinions seem polarized also for ‘Extrinsic barriers’.

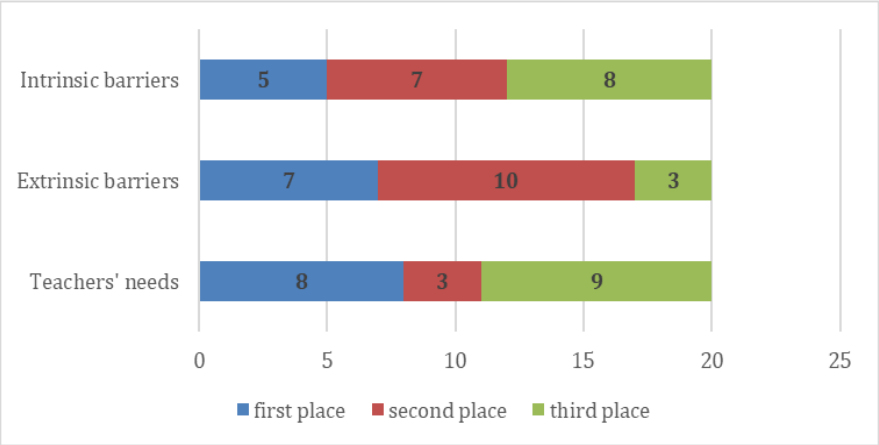

Figure 5.1 - Ranking of the three categories of factors (Round I)

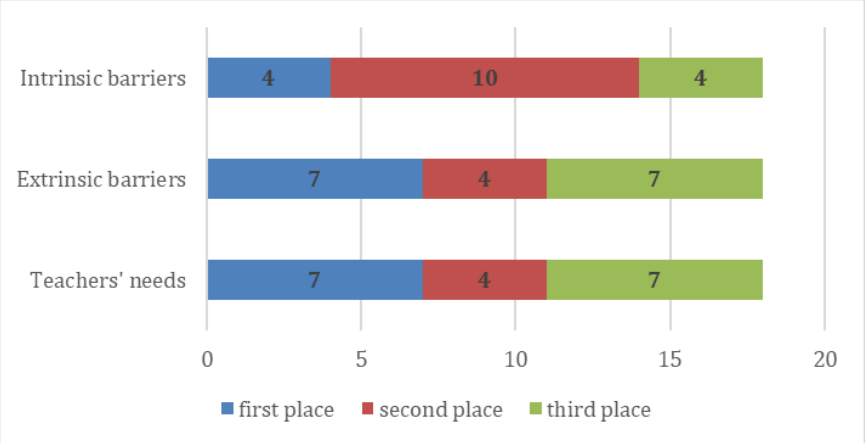

Figure 5.2 - Ranking of the three categories of factors (Round II)

In both rounds, rankings were analysed using the Friedman test (Friedman, 1940) calculating a variance over the mean ranks, to see if one aspect got a higher rank compared to the others; the test did not show significant difference in both

rounds (Round 1= (χ2: 1,3 (2); p=0.522); Round 2 = χ2: 0,0 (2); p=1)). Therefore, the three categories were considered as having a similar impact on adoption.

In the second round, the experts were asked to answer a multiple-choice question about the category of factors on which future research should focus most: 'Teachers' needs' seems to be the aspect that most experts consider worthy of further exploration (16 out of 18), followed by 'Intrinsic barriers' (11 out of 18) and 'Extrinsic barriers' (10 out of 18).

5.3.3 Influence of needs and barriers on the adoption

In Part B, participants were required to rate the influence of specific teachers' needs and barriers on the adoption of Learning Design methods and tools.

As to teachers' needs, mean, median and InterQuartile Range (IQR) were calculated for each item in both rounds. The Wilcoxon test was calculated to compare the results of the first and second rounds, to identify possible changes in experts' opinions.

Table 5.1 reports the results obtained for the two rounds and Wilcoxon test.

Table 5.1 - Teachers' needs: central tendencies and levels of dispersion for the two rounds, Wilcoxon test results

Needs	*First round*			*Second round*			*Comparison between first and second round*
	Mean	Median	IQR	Mean	Median	IQR	Wilcoxon V
Easiness of use	4.5	5	1	4.83	5	0	2.5
Time saving	4.45	5	1	4.78	5	0	2
Support for reuse and adaptation	4.2	4	1	4.1	4	0.75	48
Coherence with the teachers' design thinking	4.1	4.5	2	4.06	4	1	36.5

Flexibility	3.9	4	2	4.33	4.5	1	6
Form of representation	3.65	4	1.25	3.72	4	1.75	32
Support for cooperation	3.5	3.5	1.25	3.44	4	1	29
Support for reflection	3.35	3	0.25	3.50	3.5	1	39

Experts' consensus was measured using the IQR. According to von der Gracht (2012) an IQR of 1 or less is a suitable consensus indicator for 4 to 5-unit scales, as is the scale adopted. The table shows that experts' reached consensus for four out of eight needs in the first round; consensus increased in the second round with an IQR of 1 or less for seven out of eight needs (only 'Form of representation' had an IQR of 1,75). According to the Wilcoxon test results, there are not any significant differences between the first and the second rounds, suggesting that experts' opinions remained generally stable. Therefore, while expert agreement increased substantially, this happened via convergence towards the median, and I observed no shift in their average opinion, just better agreement.

To evaluate whether the dispersion of the answers (namely how experts' answers were distributed in the five levels of the scale) changed in the two rounds, I tested whether the balance among responses changed between the two rounds of the Delphi study (Levene, 1960). Variance homogeneity increased in two items:

- Ease of use (p= 0.0017**)
- Time saving (p=0.0009***)

This result indicates that experts converged on evaluation of these two needs, while for the others answers' distribution did not significantly change.

During the first round, experts were also required to suggest possible needs that were not detected in the literature review; as described in section 5.2.3 suggestions were coded by two independent coders. The two coders identified nine needs:

1. Need for support for deployment
2. Need for support of learning analytics informing Learning Design
3. Need for support for orchestration (Dillenbourg & Jermann, 2010)
4. Need for interoperability among Learning Design tools
5. Need for support for conceptualization/or creation of learning designs
6. Need for low costs solutions
7. Need for examples

8. Need for reward for sharing
9. Need for support for pedagogical creativity.

Below I further analyse and discuss each category of needs that were expressed by the experts, and I provide an illustrative set of excerpts of the experts' views. The complete set of experts' views can be found in Appendix 2. Results.

Five experts expressed needs that were categorized as ‘Need for support for deployment’, referring to the ‘translation’ of the designs into the tools used in the delivery of the learning activities (virtual learning environments, learning management systems, social media, etc.). Two experts motivated their answers saying that this kind of support can show the advantages that the design process may have at the level of deployment of the activities:

> “The need to translate designs into technological tools (e.g., Moodle) that support them. I believe that highlighting the mapping that instructional designs have with their technological support can favour their adoption”

> “The need of connecting with learning tools they use to support the activities and other aspects of their context because they see the practical and direct use of the designs”

The attention towards deployment was confirmed in the recent update of the literature review (see section 4.5.1)

The issue of the integration between design and delivery tools was raised by the researchers in the field as presented in section 2.4.2 and remains a crucial point in the experts’ opinion.

Three experts expressed needs referred to the interoperability of the Learning Design tools, one for example said:

> “Interoperability/translation between LD tools can be quite important once the routine of doing LDs is internalized - so that I can take my designs made with one tool, to another tool that may be in use in a different context/team, etc. (although probably teachers themselves are not aware of this kind of need)”

The possibility to export/import the designs in different tools would be, probably, helpful in terms of sharing and reusing of designs.

Two experts mentioned needs linked to the orchestration of learning activities that were categorized as ‘Need for support for orchestration’. One referred to the possibility to visualize the plan and the actual delivery of the learning activity:

> “It can also be important to have some kind of "enactment support" in the sense of having a (simplified) visualization of what was planned and the current time, so that the teacher can track deviations”

while the second referred to a technical support provided both to school and students at home:

"Need for someone that solves technological problems at school, the need for someone that solves technological problems for students when they use technology at home"

One expert referred to the use of data on learning outcomes as a support for the enactment and reflection on the design; this was categorized as 'Need for support of learning analytics informing Learning Design'.

"Not sure it can be labelled a "LD need", but having some kind of data gathering (e.g., of student outcomes, of participation, etc.) mapped and visualized onto the LD can be very useful, both during the enactment and for later reflection and re-design"

The support of learning analytics to learning design was also one of the needs emerged in the update of the systematic literature review (see section 4.5.1).

The need of tools able to support conceptualization or creation of learning designs was cited by one expert:

"Support for creating a design - important because teachers are more likely to create a new design than to adapt and reuse an existing one. Also, different thought processes are involved in creation vs adaptation/reuse"

while another suggested the need for support for pedagogical creativity.

The need for examples from which teachers can start to design their learning activities was mentioned by one expert:

"One factor (even if it is not a need) that could influence adoption is having tried out (as a student or - at least - as a witness) a model and perceived it works. This is a kind of reuse, but not reuse of a design, rather, it is reuse of a model…"

Finally, one expert suggested keeping the costs of new Learning Design tools low in terms of money and time and another highlighted that the context should reward the sharing and reusing of learning designs:

"If the context provides a reward for sharing Learning Design among teachers (such as using each other's designs so as to save on preparation time), then this encourages this approach. However, many academics work in a "solo" way in their courses, so there is little reason for them to share"

In the second round, experts were required to also rate the needs proposed by them. Measures of central tendency and dispersion were calculated as well as the difference between the mean of respondents' answers and the midpoint of the

scale, so as to identify those that gained a significantly higher evaluation than the expected value (3) in terms of impact (see Table 5.2).

Table 5.2 - Teachers' needs proposed by the experts: central tendencies and levels of dispersion for the second round and Wilcoxon test results

Need	*Mean*	*Median*	*Standard deviation*	*IQR*	*Wilcoxon V*
Support for deployment (in technology-based learning environments)	3.94	4	0.85	1.50	100**
Support of learning analytics informing Learning Design	3.11	3	0.74	0.75	17.5
Support for orchestration	3.39	3.5	1.01	1	57
Interoperability among Learning Design tools	3.17	3	0.96	1	40
Support for conceptualization/or creation of learning designs	4.17	4	0.83	1.75	91**
Low cost (money and time) solutions	4.33	4.5	0.82	1	148**
Examples of designs	4.50	5	0.69	1	136**
Reward for sharing	3.65	4	0.83	1	67*
Support for pedagogical creativity	4.11	4	0.99	1	123**

(Significant: p<0.05*; p<0.01**; p<0.001***)

According to the results shown in Table 5.2, experts' consensus as far as the new needs proposed was high; the IQRs is 1 or less for seven out of nine needs. Needs that are related to educational aspects (e.g., examples of successful designs, support of conceptualization and pedagogical creativity) seem to be attributed higher importance, as compared to needs more related to technological aspects (e.g., interoperability among LD tools, support of learning analytics) since they got a significantly higher rate.

Also, for barriers to adoption central tendencies and level of dispersion were calculated for both rounds; the stability of experts' opinions was checked through the Wilcoxon test. Related results are reported below in Table 5.3.

Table 5.3 - Barriers: central tendencies and levels of dispersion for the two rounds, Wilcoxon test results

Needs	*First round*			*Second round*			*Comparison between first and second round*
	Mean	*Median*	*IQR*	*Mean*	*Median*	*IQR*	*Wilcoxon V*
Time/workload factors (Extr.)	4.45	5	1	4.83	5	0	2.5
Lack of institutional support (Extr.)	4.15	4.5	2	4.28	5	1.75	8.5
Lack of adequate teacher training (Extr.)	4.05	4	1	4.33	4	1	9
Conceptual complexity of methods and tools (Extr.)	4	4	0,5	4.17	4	1	24
Adoption by peers (Extr.)	3.75	4	1	3.72	4	1	16

(Scarce) use of ICTs in teaching practice (Intr.)	3.35	3.5	1	3.61	4	1	22.5
(Lack of) motivation (Intr.)	3.95	4.5	2	4.11	5	1.75	27

Legenda: Extr. (Extrinsic); Intr. (Intrinsic).

Regarding the experts' consensus, results show an IQR of 1 or less for five out of seven barriers in both rounds. Regarding the two barriers with a lower consensus ('Lack of institutional support' and 'Lack of motivation') the IQR slightly decreased (from 2 to 1,75). The analysis of the distribution of responses reveals that most of the experts (61% and 55%) rate 5 both barriers, thus showing an agreement among the experts although there are also some outliers (see Figure 5.3). As in the case of needs, also for barriers the Wilcoxon test did not show significant differences between the first and the second round; this means that experts' opinions remained stable across the two rounds. As to the dispersion of the answers, the difference of variance homogeneity in the two rounds was calculated. Variance homogeneity increased in one item: `Time workload factors' (p=0,002***) indicating that experts' opinions converged.

Similarly to the case of needs, the experts also proposed further barriers beyond those listed in the questionnaire of the first round. As for needs, two coders coded the answers following the procedure described in section 5.2.3 and identified six new barriers (four extrinsic and two intrinsic):

1. Extrinsic - Lack of support for orchestration
2. Extrinsic - Scarce adaptability of the tools
3. Extrinsic - Scarce adherence to teachers' needs/practice
4. Extrinsic - Negative attitudes of students towards Technology Enhanced Learning (TEL) approaches
5. Intrinsic - Lack of creativity
6. Intrinsic - Lack of confidence

As for the needs, I discuss each category of barriers added by the experts, and I provide some excerpts reflecting the experts' views. The complete set of experts' excerpts can be found in Appendix 2. Results.

Regarding extrinsic barriers, two experts referred to the scarce adherence of tools to teachers' needs and practices; to overcome this limit, one suggested to implement co-design (or participatory design) involving teachers:

"The design of the tools could consider more the participation of teachers using co-

design or participatory design methods so that they are closer to their mindsets and needs"

Strictly linked to the above-mentioned barrier, there is the scarce adaptability of the tools to the different contexts. In this line one expert commented:

"A different barrier I see has to do with the alignment of the LD tools provided, and the particular characteristics of the curriculum. For the adoption of LD tools, teachers should be able to customise or adapt them to the language, conceptual structure and requirements of the official curriculum they are implementing. So, LD tools should be flexible enough to be adapted to different curriculum requirements in different parts of the world"

The concept expressed by the expert is highly intertwined with the discourse on tools flexibility that was identified among the needs in the original list proposed. The issue of the scarce adaptability of tools emerged also in the update of the systematic literature review (see section 4.5.2).

A barrier identified by one expert is the lack of support to orchestration; this barrier is specular to the need for orchestration support that was identified among the needs.

*"*Lack of leadership. It deserves to be considered because someone must be supporting questions and problems that appear in the implementation"

Two intrinsic barriers were added by experts: the lack of creativity which may limit the capability of the teachers to design innovative learning activities and the lack of confidence.

As in the case of the needs, measures of central tendency and dispersion were calculated as well as the difference between the mean of respondents' answers and the midpoint of the scale (Wilcoxon signed rank test). Results are reported in Table 5.4.

Table 5.4 - Barriers proposed by the experts: central tendencies and levels of dispersion for the second round and Wilcoxon test results

Need	*Mean*	*Median*	*Standard deviation*	*IQR*	*Wilcoxon V*
Lack of support for orchestration (Extr.)	3.44	3	1.01	1	43
Scarce adaptability of tools to context/curriculum (Extr.)	3.83	4	0.96	2	63*
Scarce adherence to teachers' needs/practice (Extr.)	4.06	4	0.91	2	66**
Negative attitudes of students towards TEL approaches (Extr.)	2.28	2	1.24	1.5	31
Lack of creativity (Intr.)	2.83	3	0.83	1	20
Lack of confidence with technology (Intr.)	3.67	4	0.65	1	72.5**

Legenda: Extr. (Extrinsic); Intr. (Intrinsic).
(Significant: $p<0.05$*; $p<0.01$**; $p<0.001$***)

According to the results shown in Table 5.4, experts reached consensus on three out of six suggested barriers (IQRs of 1 or less). Experts reached consensus in the rating of 'Lack of confidence with technology', 'Lack of support for orchestration' and 'Lack of creativity', while IQR was higher than 1 for 'Scarce adherence to teachers' needs/practice', 'Scarce adaptability of tools to context/curriculum' and 'Negative attitudes of students towards TEL approaches'. For 'Scarce adherence to needs' and 'Scarce adaptability of tools to context', experts' ratings were polarized between the points 3 and 5 of the Likert scale, for

'Negative attitudes of students towards TEL' experts' ratings were mostly between the points 2 and 3 (Figure 5.3).

As to the barriers having a significantly higher evaluation than the expected value (3) in terms of impact (Wilcoxon test), the 'Scarce adherence to teachers' needs and practices' is the barrier that reached the highest mean value, followed by 'Scarce adaptability of tools' and 'Lack of confidence with technologies'.

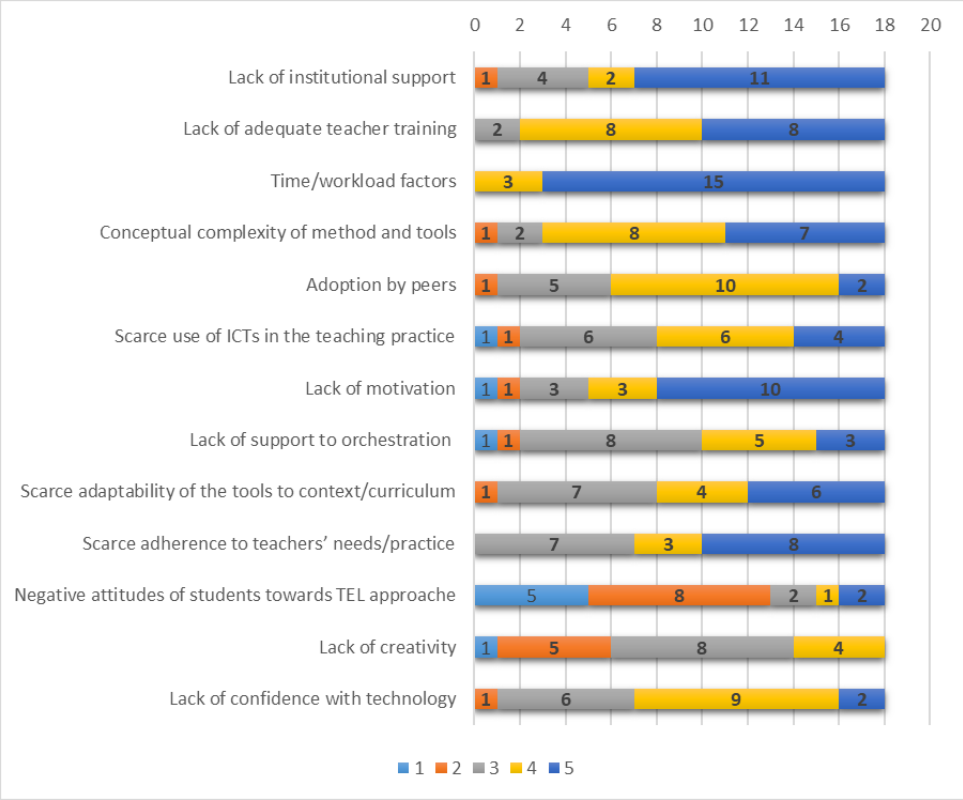

Figure 5.3 - Answers' distribution in the second round (Likert scale from 1 'Not at all' to 5 'Extremely')

5.3.4 Solutions to support adoption

In the second round, the experts were also required to suggest possible solutions for fostering the adoption of Learning Design methods and tools.

Categories of solutions are presented here with some accompanying excerpts; the complete list of experts' excerpts is available in Appendix 2. Results.

Four experts suggested organizing training initiatives on Learning Design in schools that involve teachers and/or principals as a possible solution for overcoming both teachers' motivational barriers and the lack of support from institutions:

"Lack of motivation is a combination of lack of awareness of the need for LD solutions and extrinsic barriers. This can be solved through the training of both teachers and headmasters"

Besides training, another solution focused on teachers is to facilitate the sharing and reuse of other teachers' experiences (in terms of success stories, templates or designs) which is mentioned by four experts:

"I suggest exploring new methods for sharing, adoption and adaptation of learning designs"

The importance of institutional support is cited by five experts. The involvement is cited in terms of commitment of the institution for adoption (one expert), and in any case two experts suggested institutional acknowledgement of teachers' adoption of innovative practices.

"[…] different kinds of solutions are needed for different issues - extrinsic issues are mostly issues of lack of institutional support (which can appear as a failure to address issues of strategy, workload, technology integration, etc) - these can be solved about an institution which makes a strategic commitment to adoption of LD (such as [name of the Institution])"

Better alignment with teachers' and institutional needs is also suggested.

"Building tools that are more aligned with teachers' practical needs (e.g., flexibility, provision of design ideas relevant to them - as examples or hints in tools) and institutional requirements (e.g., documenting student's expected workload in the learning design to be considered together with other designs so the institutions value the use of learning design tools)"

Building teachers' communities seems to represent a solution in the view of two experts, since communities provide a context in which teachers can design together and share ideas and designs. Creating favourable contextual conditions is also considered important.

"An issue quite important is working with groups of teachers aiming to build communities that design together and share ideas & ready designs"

The issue of the maturity of tools seems to be another crucial point for three experts. One expert expressed the need for new methods supporting sharing and adaptation of learning designs; another mentioned the need for robust, free and easy to use tools:

"Another barrier is the unavailability of solid tools and methods that are free and easy to use for teachers. This can only be solved if some of the existing prototypes become extensively usable. This can be achieved with appropriate collaborations between researchers and developers who can transform the prototypes in widely usable tools"

A third expert suggested a specific solution (reusable Learning Design templates) that would facilitate sharing and reuse, and that might support easy implementation in the classroom; the solution should also be robust and flexible, incorporating analytics features that could enrich traditional, non-explicit planning:

"[...] If the templates are easily implementable in the classroom (e.g., automated deployment and orchestration support), robust/flexible enough (no technical glitches, work in teacher's particular context with minimal customization), and they are rich enough to provided added value over classic non-explicit planning (e.g., useful analytics tailored to the design, etc.), then maybe teachers would use such solutions"

Therefore, despite the considerable variety of methods and tools available, experts think there is still room for improving existing solutions.

The active involvement of teachers in tool development is suggested by two experts:

"We need a large-scale effort of participatory design of LD tools. Such a project will expose the true barriers (i.e., not just the educated guesses of respondents to this survey) and identify viable solutions for them"

Only one expert focused on a specific technological solution, namely 'reverse engineering learning design', achieved by means of sensors and data logs. Once analysed, the data thus acquired should lead to the creation of designs derived from the concrete educational experiences that generated the same data.

Finally, one expert highlighted the need to work constantly on the interplay of the three categories of factors (needs and both barrier types):

"These factors don't exist in isolation of course, so it would be fruitful to study the interplay between teachers' needs, intrinsic and extrinsic factors, to identify what emergent phenomena arise"

5.4 Discussion

The Delphi study was carried out in the second phase of the thesis work to further elaborate on the results of the systematic literature review, so as to understand in depth the importance attributed by experts to the three categories of factors identified in the systematic literature review and outline possible solutions for supporting the adoption of Learning Design methods and tools.

As far as RQ1: *What are the factors affecting the adoption of Learning Design methods and tools?* the Delphi study aimed at understanding if the experts attributed a different importance to the three categories of factors and how they ranked the importance of the single teachers' needs and barriers identified through the systematic literature review. Moreover, the study asked experts whether they thought that further needs and barriers should be added to the list.

Results from the two rounds suggest a low consensus among the experts about the relative importance of the three categories. In the second round I saw a shift towards consensus for 'Intrinsic barriers', while the experts' positions remained polarized for 'Teachers' needs' and became polarized for 'Extrinsic barriers'. The three categories of factors were considered almost equally important in affecting the adoption of Learning Design methods and tools. Nevertheless, when called on to express their opinions in relation to which of these categories of factors would deserve further study, 'Teachers' needs' were selected by almost all the respondents in the study (16 out of 18, 88%), followed by 'Intrinsic barriers' and 'Extrinsic barriers'. This result did not undergo a second round for checking the stability of the opinion, given that experts showed a high level of consensus. Since in the systematic literature review only five out of 20 papers were found to address teachers' needs, this suggestion shows a greater focus of the experts on teachers' needs as compared to the focus of the available publications. This gap between attributed importance in the literature survey and the views expressed by the experts may be due to several factors, not least of which the nature of funding and research opportunities. Indeed, research activities are often constrained by national or European funds, which inevitably influence their directions; this may have led to a greater focus on innovation and technological development rather than on the analysis of teaching practices. Another reason may reside in the increased awareness of researchers that methods and tools need to be better aligned with the actual teachers' practices.

In the two rounds I also collected the experts' opinions about the impact of specific needs and barriers identified in the systematic literature review on the actual adoption of methods and tools. Consensus among the experts was high for the majority of the items (22 out of 30) and these opinions remained stable across the two rounds (see Table 5.1 and Table 5.3).

Among the needs, the three needs that got the highest mean values, and therefore were considered to have the greatest impact on adoption, were the ease of use of tools, the capability of the methods/tools to help the teacher save time and the flexibility. These results show that experts are aware of the need of the teachers to optimise their work in terms of time and effort and that this is something to bear in mind in the development of Learning Design methods and tools.

Another need rated as important is the alignment of methods/tools with teachers' design thinking. While usability of tools is a frequently studied topic in research on Learning Design, the consistency of the methods and tools proposed with the existing teacher design practices is less commonly explored and probably not adequately valued in the process of developing methods and tools. This issue was already pointed out by some authors in the field (Bennett et al., 2015; Laurillard et al, 2013), who highlighted that Learning Design tools should support the way teachers approach their everyday practice, even if the tools' aim is to enhance such practice. In this sense, it seems necessary to strike a balance, both in terms of research and tool development, between the analysis of teachers' practices and those researchers in Learning Design want to promote, so as not to create too wide a divide that might discourage teachers from making use of learning design methods and tools.

In relation to barriers (Table 5.3), the results of the study suggest that the two intrinsic barriers ('Lack of motivation' and 'Scarce use of ICTs in the teaching practice') are considered as having a weaker impact on adoption than most of the extrinsic barriers. Regarding motivation, which is clearly the basis of human behaviour, this could be because experts see motivation as something that can be influenced/increased by addressing teachers' needs and external barriers.

Moreover, it is surprising that the 'Conceptual complexity of methods and tools' (which can be considered the counterpart of the 'Ease of use', that is the need who got the highest rating) is considered less important than other, more transversal barriers, like 'Time and workload factors', 'Lack of institutional support' and 'Lack of adequate teacher training'. Experts seem to attribute great value to these factors, but this seems not to be reflected in the available literature, as discussed in chapter 4.

The barrier suggested by experts that was considered most significant (see Table 5.4), was 'Scarce adherence to teachers' needs/practice', which represents the counterpart of the need for coherence expressed in the list of teachers' needs; for this barrier there is no consensus among the experts, but their opinions tended to be distributed between the mid and the highest point of the scale. 'Lack of confidence with technologies' received a high rate as well as the 'Scarce adaptability to context/curriculum', which can be seen as the counterpart of the need 'Flexibility'. These results are in line with the research of Celik and Magoulas (2019), whose recent analysis of some Learning Design tools, carried out from a socio-

material perspective, points out a misalignment between the analysed tools and teachers' practice (e.g., the time factor and need to design collaboratively), and national and institutional standards.

Regarding RQ2, that is: *What actions/solutions can support the adoption of Learning Design methods and tools?,* the suggestions by the experts to overcome barriers mostly reflect educational perspectives. These suggestions mainly concern extrinsic and transversal barriers, like the lack of institutional support. The role of institutional policies is given high priority, and the experts also suggest involving management in training activities. Institutional acknowledgement is considered important to overcome other extrinsic barriers (time/workload issues, for example) as well as intrinsic barriers like teachers' motivation. This focus on actions that can be taken at the institutional level to support adoption demonstrates a renewed awareness that in proposing a method/tool it is paramount to address all the actors involved and not just teachers. Teachers remain, anyway, an important target, indeed experts highlighted the central role of raising teachers' awareness about the significance of Learning Design through training. In line with the attention demonstrated towards teaching practices, more than one expert invoked participatory design and alignment with teachers' and institutional needs. The proposed active involvement of teachers in the design of tools could bridge the gap highlighted among the barriers, but it may not be easily achievable, as teachers would have to become aware of the benefits such a tool could bring to their practice.

As for the systematic literature review, the methodology of the Delphi study was described in the paper discussing the implications of the use of technologies to support the research (Dagnino et al., 2020). For carrying out the Delphi study I relied on Limesurvey. The software helped manage some aspects that are usually considered time consuming in these kinds of studies (e.g., communications with the panellists, managing multiple survey rounds, and gathering the participants' responses and recording them). In this case, Limesurvey relieved me from tasks like sending invitations and questionnaires or recording the answers in a database. As Cole, Donohoe, & Stellefson (2013) highlighted, the e-Delphi study is also effective and efficient in overcoming geographical barriers, saving time and money, as this was also true in my experience. The software fosters the perception of anonymity, as Limesurvey automatically assigned a code to participants, and the accuracy of data collection, that were registered directly by the system (Roztocki, 2001). On the other hand, the online Delphi study was not free of challenges. Emails sent by the system were sometimes blocked by the SPAM features of recipients' mail providers and in any case risked being ignored more than a personal invitation. The automatic invitation created quite 'impersonal' interactions between panellists and me. Even more importantly, I cannot exclude inaccuracies in the interpretation of the answers: the open-ended answers provided in Limesurvey

by the panellists were often too short and sometimes difficult to interpret. The impersonality of the situation might have affected participants' contribution. Unfortunately, to the best of my knowledge very limited attention has been paid so far to the way participants change their behaviours when observation and data collection happens through technology. Finally, some issues were also raised by respondents regarding Limesurvey at technical level, like the impossibility to modify previously answered questions. Descriptive and inferential statistics were calculated with *R*, a language and environment for statistical computing and graphics that I used with the help of an experienced statistician.

5.5 Conclusions

To conclude, the results of the Delphi study support the idea that teachers' needs and barriers to adoption are factors that are tightly intertwined and need to be considered as a whole, while studying the adoption of Learning Design methods and tools. This should be the approach taken by researchers in the field. Nevertheless, according to experts, more effort should be directed to study teachers' needs, since they have been frequently overlooked in recent research. The rating of the needs highlighted that methods and tools should be designed to serve teachers and enhance their practices while saving them time and effort. This approach calls for a greater collaboration between researchers, teachers and institutions, to balance the introduction of innovation in terms of Learning Design methods and tools with current needs and practices. Results also showed that, among the barriers, experts highly rated transversal (not linked to single tools) and contextual factors (e.g., institutional support) and oriented their proposed solutions to tackle them. These results show the current experts' awareness about the importance of contextual and individual factors which may affect adoption and may imply that research in the field in the future will take on a more ecological perspective, shifting from the 'tool oriented' approach that was detected in the literature review (see chapter 4) to a more contextualized one.

As mentioned in the methodological chapter (chapter 3), the Delphi study represented a way to go a step beyond the systematic literature review, in which the problem of adoption was explored through the analysis of teachers' needs and barriers (see chapter 4). The systematic literature review allowed me to identify both of them but did not allow to define their relative importance. In the Delphi study experts rated their importance allowing me to identify which, in their view, may have a greater impact on adoption. The results of the Delphi study have been matched with the analysis of the same needs and barriers in a real setting, the case study that will be presented in chapter 6. Similarly, some of the suggestions given by experts to overcome the above-described barriers have been applied in the case

study to address the barriers in that context and will be discussed in chapter 6. In chapter 7 the final conclusions resulting from the cross-analysis of the data will be presented.

Chapter 6
Case study

This chapter reports the design, implementation and results of the case study, one of the methods adopted in this research project (see Figure 4.1) and follows the systematic literature review (see chapter 4) and the Delphi study (see chapter 5). The case study was carried out in order to study the set of factors (teachers' needs and barriers), affecting the adoption of Learning Design in a real context. Moreover, this case study also served as the setting for testing possible actions/solutions to support the adoption of Learning Design tools and methods. The case study was implemented in an institution for vocational training with the participation of a group of teachers involved in a long-term non-intensive training path in Technology Enhanced Learning (TEL) and Learning Design. During the training that lasted two years and a half, teachers employed two Learning Design tools and their use was evaluated through multiple sources of information and analysis methods (questionnaires, interviews, analysis of the designs, etc). The resulting data and findings contributed to provide responses to RQ1 of this dissertation. At the same time, some solutions to support the adoption were proposed and tested to assess whether they can smoothen the process of adoption and the resulting data and findings were used to nurture RQ2.

6.1 Introduction

As said in chapters 1 and 3, the overall research project was carried out using a mixed method design, envisaging different methods (a systematic literature review, a Delphi study and a case study) and involving different stakeholders/participants at each step (teachers, researchers and experts).

Figure 4.1 shows the flow of the research and the RQs tackled with the different research methods.

The case study which was carried out in two iterations (see section 6.6), complemented the findings of the systematic literature review and the Delphi study and had the aim of analysing, in a real setting with in-service teachers, the factors (teachers' needs and the barriers) affecting adoption of Learning Design methods and tools that emerged from the review itself. To reach this goal, a convenient and accessible context was identified in which a training on Learning Design was carried out. This was really important in order to collect data from the field with a clear focus both on needs and barriers, that is an innovative approach compared to the published research; indeed, the available research mainly focuses on tools perception and usability evaluation (see section 4.3). Exploring needs and barriers in a real context gave me the possibility to study how teachers themselves conceptualize both of them. The analysis of needs and barriers in the case study also complements the findings of the Delphi study (see chapter 5) in which experts have been called to rate the relative importance of the different factors at play. The importance given by the teachers to the different needs and barriers is a further source of information that can, as the results of the Delphi study, steer my attention.

Another aim of the case study was to test some solutions/actions oriented to support the adoption of Learning Design methods and tools. These solutions/actions address specifically the needs and barriers which were detected in the systematic literature review and eventually emerged in the specific context of the case study. Solutions were initially conceived and proposed by me and later enriched with others proposed by the experts involved in the Delphi study (see section 5.3.4). The case study was conducted in the context of a vocational training institution, in which teachers were involved in a long-term professional training in Technology Enhanced Learning. During the training, Learning Design was introduced both during theoretical lectures and through the actual use of software tools able to support the design process. This setting allowed me to monitor the use of the tools and to collect data about teachers' needs and barriers precluding adoption.

In the first sections of this chapter the study is described starting from the definition of the type of case study (section 6.2) and its conceptual structure (section 6.3). Each of the elements introduced in the conceptual structure is described in the following sections (6.4, 6.5, 6.7). Section 6.6 reports the design of the case study. Finally the development of the case study and the results are reported in sections 6.8 and 6.9 and discussed in section 6.10.

6.2 Type of case study

As already mentioned in section 3.3.3, the case study in this thesis is an instrumental case study; as defined by Stake (2005), an instrumental case study has the main aim to "*provide insight into an issue or to redraw generalisation*" (p. 445). Indeed, the focus of the thesis is not the specific case itself but the problem of the lack of adoption of Learning Design methods and tools in this context. A vocational training institute in which a group of teachers were trained in Technology Enhanced Learning and Learning Design for the first time was identified so that the process of adoption could be studied from the very beginning. This case study allowed me to investigate the needs of the teachers as well as the barriers that these teachers met in the adoption of the methods and tools proposed during the training, by monitoring teachers for the whole duration of the training. The fact that the training was underway allowed also identifying possible actions/solutions to be implemented to support the adoption. As will be described in section 6.4, this case study cannot be considered a standard instrumental case study since it was combined with the design-based research methodology (Design-Based Research Collective, 2003) to study the implementation of the actions/solutions and the analysis of their impact on adoption.

6.3 Conceptual structure of the case study

The structure of the case study is represented here (see Figure 6.1) according to the scheme proposed by Stake (2005). The general scheme was presented in section 3.3.3.2 and has the aim to describe all the elements of the case study.

In the following sections I will describe the elements at play, except the Learning Design context that was already described in chapter 2. As said above, the case study was selected on a convenience basis, since I needed to find a context in which teachers were trained in Learning Design for the first time, in order to explore the methods and tools adoption. The context of the case study is described in section 6.4; the issue, thematic statements and information questions that guided the case study are presented in section 6.5. Finally, section 6.7 describes participants and data collection methods.

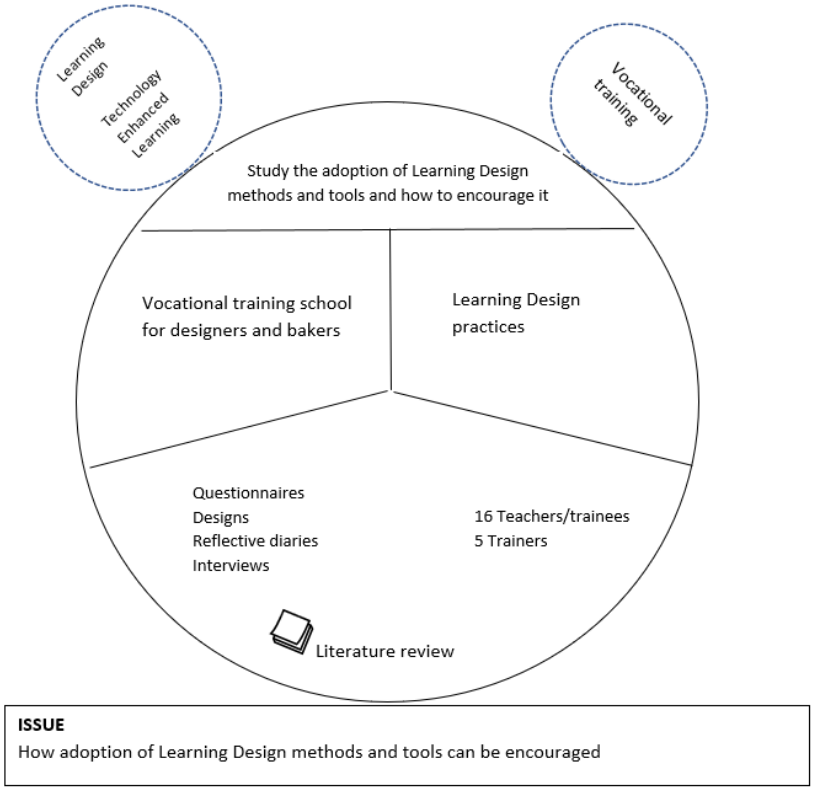

Figure 6.1 - Conceptual structure of the case study

6.4 Context of the case study

6.4.1 The school

The case study was carried out in a vocational training institute for bakers and graphic designers (Figure 6.2), located in Vimercate[3], a town in the Monza and Brianza province (Lombardia region) in the northern part of Italy.

[3] https://www.ecfop.it/sede-di-vimercate/

The province is heavily urbanised, includes municipalities that previously fell within the province of Milan (Metropolitan city) and is characterised by small towns and villages. The school gathers students from the neighbourhood.

Vocational training in Italy is a parallel educational path under the regional competence, which is differentiated from the school education paths that are under the Ministry of Education competence. It is aimed at training young people who want to enter the world of work as soon as the law permits. The duration of the program is currently varied and depends on the type of educational centre. In Italy the vocational training centres provide three-year/four-year programs of studies and are focused on specialised practical subjects in one sector, aimed at achieving a professional qualification or a professional 'diploma'[4]. On the contrary, the professional paths within the school education are more complex with a study plan that can go up to five years with the possibility to get a qualification after three years.

The vocational training institute in Vimercate is small but is managed by a catholic training institution (ECFoP) which also comprehends other schools (four) in Lombardia. The institution was recognized as a vocational training provider by the Lombardia region in 1973, therefore students can attend the school without any payment. The school in Vimercate was opened in 2012. The central administration and the director of the institution are located in the biggest and oldest school in Monza, but all the schools have a local responsible and administrative personnel.

The Vimercate school (Figure 6.2) covers two areas of training (bakers-pastry chefs and graphic designers) with a four-year program study each (three years to get a qualification plus one optional year leading to a 'diploma' of vocational training), for a total of 8 classes. The training hours are 990 in each year and are organised in modules (subjects). During the second and third year, students are involved in apprenticeships for 320 and 420 hours respectively.

Since the school opened, the number of students has been steadily increasing to reach about 1500 in 2019/20, 1547 in 2020/21 and 1546 in 2021/22 school years.

The student population is composed almost equally by males and females (in the last three school years the percentage of female students was around 54-55%). It includes both students who attend the school as their 'first choice' and students who have failed in traditional school education paths, for those the vocational training can be considered a 'second choice'; these students are not always motivated to attend the lessons. Moreover, the institute enrols every year several students with physical and cognitive disabilities, learning difficulties, behavioural problems, etc. (about 15-16% of the students).

[4] Italian Ministry of Labour and Social Policies https://tinyurl.com/37ykbba5

The teaching staff is composed of teachers and professionals (who are in charge of teaching the modules/subjects that are specific for the professions, in this case bakers, pastry chefs or graphic designers), tutors and supporting teachers (who have the role of supporting students with disabilities). The staff members have different backgrounds in teaching: some of them are just professionals (bakers, graphic designers) and were not trained for teaching in any way, others (teachers in traditional subjects) have a degree and some of them have a background in education or pedagogy.

Figure 6.2 - The school (outdoor and indoor)

At the beginning of each school year, teachers are asked to provide a macro-design of their teachings, starting from the official regional curricula. This is mandatory and is done through a digital tool. The tool is aimed at describing modules (that are subjects, such as English, maths, informatics). For each module, the teacher is expected to describe the contents in terms of knowledge, duration of the unit, teaching method, competences, and abilities addressed, tools adopted, evaluation. While some fields are open ended (e.g., knowledge, duration, tools)

other fields, like competences and abilities, are set with a drop-down menu and the teacher should select them from lists that are established for each subject by the Region (that is in charge of vocational training). The tool does not allow a detailed design (e.g., objectives, resources) of single lessons or activities.

The exemplar screen (Figure 6.3) is an extract of the Module 'Communication' of the graphic design training area.

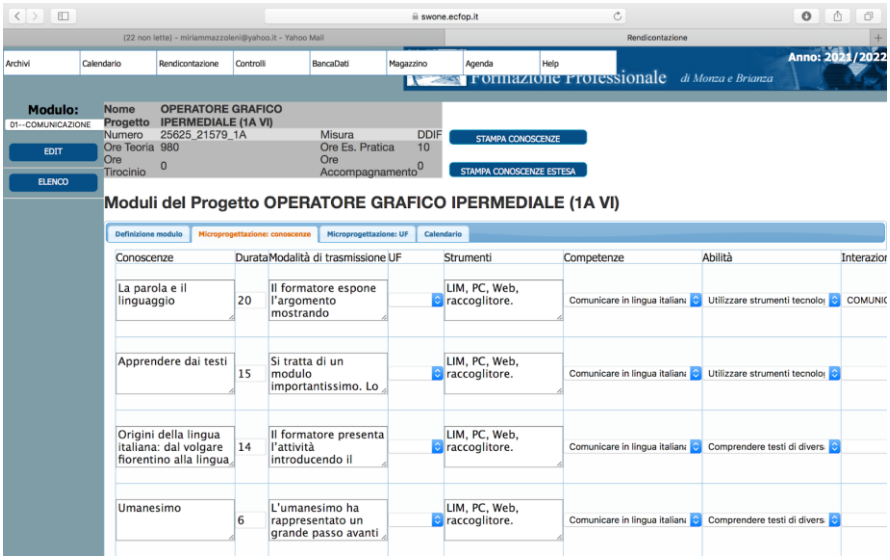

Figure 6.3 - Screenshot of the tool

The first column is dedicated to knowledge (in this example the teacher identified the following topics: 'Words and language', 'Learning from written texts', 'Origins of the Italian language: from Florentine vernacular to language', 'Humanism'), the second column is about the time required to cover the topic (e.g., 20 hours for the first topic, 15 for the second, etc.), the third column is about the teaching strategy (e.g., for the first topic the teacher describes a transmissive strategy), the fifth column is about the tools that the teacher intends to use (e.g., interactive whiteboard, personal computer, web, folder). As said above, competences and abilities need to be selected from a drop-down menu. In the example screenshot, the teacher selected one competence for all the topics ('Communicating in Italian') and two abilities ('Using technological tools' and 'Understanding different kinds of texts').

Moreover, the teacher scheduled the contents in the school year calendar (see the tab 'Calendario' in Figure 6.3). Indeed, given that in Italy apprenticeship is mandatory for vocational training, teachings in class do not cover the whole school year, but are alternated with apprenticeships/internships. The lesson schedule is not fixed for the whole school year and not all teachers teach in the same classroom in the same period of the school year.

Besides, the school offers additional activities (such as, talks with professionals, psychologists' interventions, etc.) during school time. Therefore, the schedule established with this design is subject to frequent (and sometimes unexpected) changes.

As far as the implementation of the lessons, in the school year 2017/18, the school underwent a significant change at organisational level, decided by the school management (the director and the local responsible): from the traditional model of classroom to the 'disciplinary laboratory classroom' model (Indire, 2016). This change was not shared 'a priori' with the teaching staff but decided by management and then communicated. Teachers attended a training day regarding the model.

The new organisation implies that each teacher remains stable in his/her classroom, while students get around the different classrooms (Pozzi, 2002). This allows teachers to have rooms specifically designed for their disciplines, enriched with specific furniture, tools, books and technology. In the Vimercate school, aisles were endowed with lockers (see Figure 6.2) where students could store their own materials for the different disciplines. The new organisation and school setting are expected to open up to innovative and active learning methodologies. For example, the opportunity to set up the classroom with the tools for a specific discipline is considered the premise for situated learning (Lave & Wenger, 1991); in fact, the availability of these tools makes the context meaningful, and students can interact with it to construct their knowledge, therefore learning may be considered as situated. Moreover, students interact with the environment and among them, this is expected to foster knowledge co-construction, namely give learners the opportunity to co-construct knowledge through the interaction with the other learners and the context. This organisation is expected also to facilitate collaborative learning experiences, due to the above-mentioned reasons (Indire, 2016).

6.4.2 Teachers' training

At the end of the school year 2016/2017, the institution decided to offer a training path in Technology Enhanced Learning to a group of teachers working in the different schools, in which some teachers working in the school in Vimercate were also involved. Learning Design was the main topic addressed during the

training: participants were trained from the theoretical viewpoint and experienced the use of some Learning Design tools. The training was carried out by the Institute for Educational Technology of the National Research Council of Italy (ITD-CNR).

The teacher training started in the spring 2017 and finished in autumn 2019, covering overall two school years and a half.

The structure of the training was organised as it is represented in the figure below (Figure 6.4):

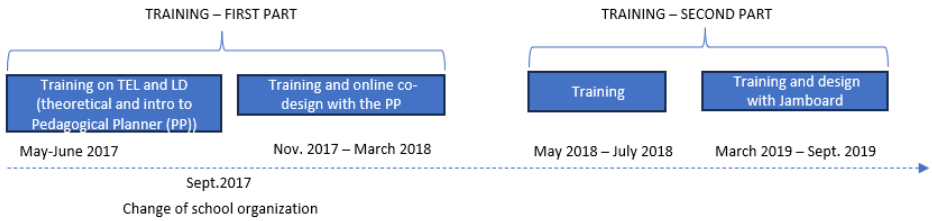

Figure 6.4 -Training flow

In particular, the training was divided into two parts:

Training - Part I, including:

- A first session (May-June 2017) consisting of 6 face-to-face lessons, lasting three hours each (for a total of 18 hours). The first session was focused on the following topics: Technology Enhanced Learning, Learning Design, collaborative learning, self-regulated learning. Learning Design was tackled during one lesson from the theoretical viewpoint; during the same lesson the first Learning Design tool was introduced (i.e., the Pedagogical Planner) and then this was used also in the following lessons: trainees collaboratively designed a learning activity and updated the design after each lesson. This allowed them to familiarise with Learning Design in general and with the proposed tool.
- A follow-up and recap session, in November 2017. During this session (2 hours and half) trainers dealt again with the topic of Learning Design, discussing how they were approaching the design process in the new school organisation. During this session participants were given a specific task: they were required to collaboratively design a learning activity with the Pedagogical Planner (PP). Teachers were given 3 months to complete the task (from December 2017 to February 2018). To supervise at distance the work of the participants a Moodle course was created. In the

Moodle, participants could find 4 forums: technical support, pedagogical support, reflective diary and café.

- A final session, aimed to provide feedback on the produced designs and discuss the work done, was carried out in March 2018.

Training - Part II, including:

A sequence of sessions, carried out from May 2018 to September 2019; in this case, the main topics of the training were: competence-based teaching and assessment, team working, laboratory classes.

Learning Design was tackled during each session of the training as an integral part; in particular:

- In the sessions on competence-based teaching and assessment (6 hours) trainers pushed a reflection on the importance of taking competencies into account during design.
- In the session about team working (3 hours) in March 2019, trainers stressed the importance of designing in teams. In this session it was suggested by the teachers themselves to use another design tool: Jamboard. This solution was suggested mainly by one teacher, but colleagues agreed. Jamboard was part of the suite adopted by the school (Google Suite). As had been the case with the Pedagogical Planner, in the period immediately following the meeting teachers were left free to spontaneously use the tool for designing learning. However, during this period, teachers used Jamboard only as a bulletin board.
- In the session about laboratory classes (3 hours), in September 2019, trainers asked teachers to (co)design a learning activity using Jamboard. Nine designs were created.

6.4.3 The tools used

Overall, during the teacher training, two tools were used by participants for Learning Design purposes:

- The **Pedagogical Planner:** a tool conceived on purpose for supporting Learning Design (Bottino, Ott, & Tavella 2011; Pozzi, et al., 2015). This tool was proposed and used in the first part of the training.
- **Jamboard[5]:** a virtual whiteboard part of the Google suite. This tool was not developed with the specific purpose of Learning Design. This tool was used in the second part of the training.

[5] https://edu.google.com/jamboard/

As far as the first tool, the Pedagogical Planner allows to manage all the phases of Learning Design: conceptualization, planning and authoring, and implementation, as described by Pozzi, Asensio-Pérez, & Persico (2016).

In the **Conceptualization** area, the designer is scaffolded in considering foundational elements of design according to the literature (Bennett et al., 2015; Norton, Richardson, Hartley, Newstead, & Mayes, 2005); these elements comprise: population, context, content domain, objectives. The tool allows to describe each element either by entering a short textual description or by a drop-down menu including a set of alternatives. Moreover, a tool for creating Mind Maps was embedded to represent the map of the contents. Figure 6.5 shows the conceptualization area.

Figure 6.5 - Conceptualization area of the Pedagogical Planner

In the **Authoring** area, the designer can represent graphically the learning path and describe each of the activities composing the learning path. The author can build a graphic representation of the activity sequence composing the available blocks; each activity can be described in detail: by clicking on the corresponding activity in the graphic area some fields for the description open up (Figure 6.6). The tool allows the designer to define graphically if an activity is mandatory (represented with a square) or optional (represented with a diamond) (Figure 6.7). The activity flow can be sequential or random and can include multiple pathways. This allows a certain degree of personalization, i.e., the designer can propose different activities to different learners (or groups of learners) pursuing the same set of objectives. More specifically, the following options are possible: single activity; ordered sequence of activities; non-ordered sequence of activities (cloud symbol); path branching (Figure 6.7). Activities can be described in detail in terms of: [1] objectives, [2] work organization, [3] tools and resources, [4] evaluation criteria.

The tool also supports the **Implementation** phase being integrated with Moodle.

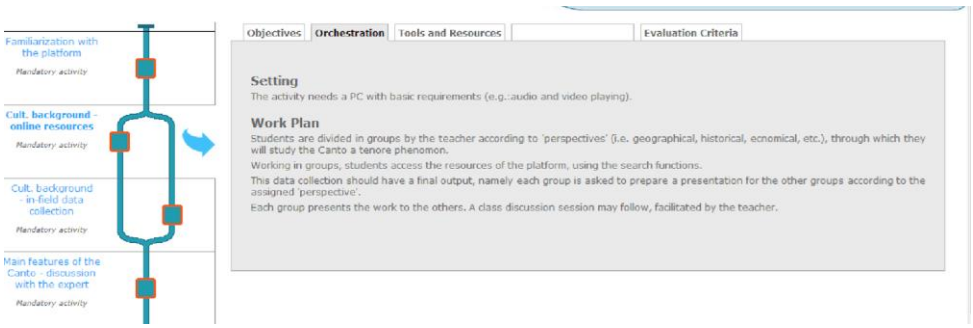

Figure 6.6 - Authoring area of the Pedagogical Planner - Description of an activity

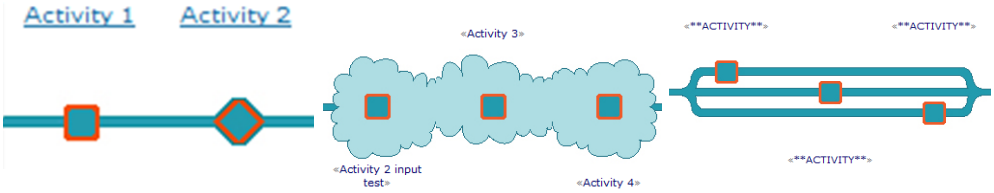

Figure 6.7 - Authoring area of the Pedagogical Planner - Types of representation of activities

The tool is conceived with the aim of supporting both the design and the retrieval of pedagogical plans. In this line, it comprises both authoring and display capabilities. Two distinct environments are available (Edit – View) which are strictly linked and directly interconnected.

Once a design is created, it can be saved and stored by the author; afterwards he/she can view the design, re-edit it and can also make it available to other users of the platform. As a matter of fact, authors can keep the designs private or make it public for the other registered users.

The second tool used by teachers was Jamboard, that is a general-purpose virtual whiteboard. It is both an app and a physical whiteboard. The app can be used on desktop and mobile tools. With Jamboard, the user can write by hand, add notes, drop images, integrate links directly from the web or Docs, Sheets, and Slides from the Google Suite (see Figure 6.8). This allows to use it for different purposes, from sketching ideas to other more complex activities. The tool allows

co-editing among teachers, therefore the tool support collaboration. The tool also allows to store the files in a common folder. It is not specifically conceived for Learning Design and does not provide any specific guide for supporting the design process, but the teachers involved in the training could ground on the 'guidelines' derived from the training and their own use of the Pedagogical Planner.

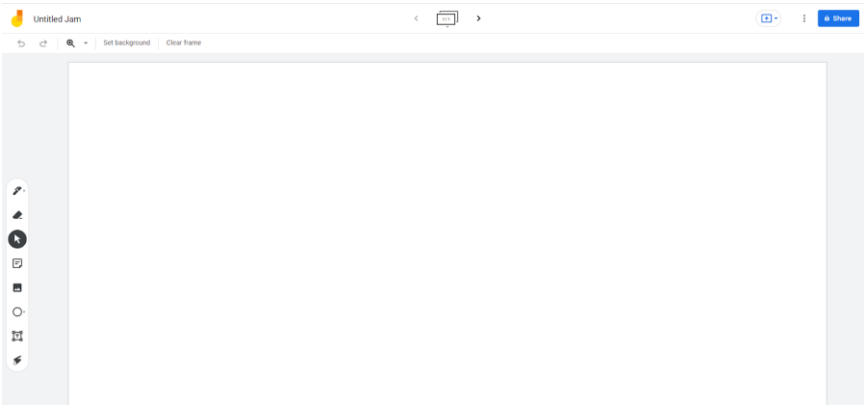

Figure 6.8 - Jamboard main page

6.5 Issue -Thematic statements - Information questions

According to the conceptual structure of the case study presented in section 6.3 (which results from the schema proposed by Stake, 2005), in section 6.4 I described the context of the case study. In the current section I present other elements of the structure: issue, thematic statements and information questions which guided the case study.

The **issue** stems from the problem of teachers' lack of adoption of Learning Design methods and tools and puts the focus on the possibility of concretely supporting adoption. The issue therefore is formulated as follows:

'How adoption of Learning Design methods and tools can be encouraged'

Addressing this issue requires first of all to understand what are the teachers' needs for designing teaching/learning activities and what can prevent them from the use of a method/tool; on the other hand, put the focus on possible ac-

tions/solutions that may address the needs and the barriers identified and therefore encourage adoption of Learning Design methods and tools.

Therefore, **two main topics of investigation (or thematic statements)** can be derived from the issue:

1. **Factors that affect Learning Design methods and tools adoption**

The first topic of investigation regards what can affect the decision to adopt Learning Design methods and tools by a group of teachers. This topic is explored in the literature (see chapter 4), in the Delphi study (see chapter 5), and in the context of the case study. In particular, I decided to investigate 1) the needs of the teachers in terms of Learning Design, starting from their already existing design practices and their desire for a tool, 2) the barriers they met to the adoption of the two tools.

Therefore, I identified the following sub-topics:

1.1 Teachers' needs for Learning Design methods and tools
  1.1.1 Teachers' design practices
  1.1.2 Teachers' desired features for Learning Design methods and tools.

1.2 Teachers' perception of the proposed Larning Design tools
  1.2.1 Perceived ease of use
  1.2.2 Perceived usefulness
  1.2.3 Likelihood of adoption.

1.3 Barriers met in the adoption of the two tools
  1.3.1 Barriers external to teachers (resources, time, etc.)
  1.3.2 Individual intrinsic barriers (barriers that pertain the teacher).

Sub-topics 1.1 and 1.3 clearly reflect the approach taken in the whole thesis, namely the analysis of needs and barriers (these lasts organized according to Ertmer's (1999) categorization). Sub-topic 1.2 provides information for both needs and barriers, indeed what teachers consider useful can reflect needs, while the ease of use and likelihood of adoption are informative as far as barriers.

2. **Actions/solutions to address what hinders adoption**

The second topic of investigation are actions/solutions to address what hinders adoption. This topic complements the previous one and it is explored in the Delphi study (see chapter 5) and in the context of the case study. Indeed, in the case study some actions/solutions were expected to be implemented to test their impact on adoption of Learning Design methods and tools.

Several aspects are investigated: the tool features able to address teachers' needs and the barriers met by teachers in relation to methods/tools, and other actions/solutions addressing needs and barriers which can be considered 'tool-independent'.

Finally, it is relevant to study if there is any effect on teachers' design practices. Therefore, I identified the following sub-topics:

2.1 Actions/solutions addressing teachers' needs and barriers

2.1.1 Tools' features addressing teachers' needs and barriers

2.1.2. Other actions/solutions addressing teachers' needs and barriers that are not linked to a specific tool but can be considered transversal (e.g., the lack of institutional support)

2.2 Changes in the design practice.

The topics of investigation are related to the research questions guiding the whole thesis. In particular the thematic statement 1 is related to the RQ1: *What are the factors affecting the adoption of Learning Design methods and tools?*, while the thematic statement 2 is related to the RQ2: *What actions/solutions can support the adoption of Learning Design methods and tools?*.

As it will be described in section 6.7, the two research questions guided the data collection process that was organized according to anticipatory data reduction schemas. **Information questions** are reported within the two schemas (see Figure 6.10 and Figure 6.11).

6.6 Design of the case study

In this study the instrumental case study method (Stake, 2005) was combined with the design-based research methodology (Design-Based Research Collective, 2003). The mixed approach appeared to be suitable for the study since the aim was not just to analyse a specific case, but also to carry out specific interventions to study and support the process of adoption.

In accordance with the phases identified by Plomp (2007) for design-based research, the study entailed the following actions:

- A preliminary research stage; in particular in the present work this entailed:
  - The already mentioned systematic literature review about teachers' needs and barriers to Learning Design adoption, which also represented the first step of the overall study (described in chapter 4).
  - An analysis of the case study contexts and participants' needs prior to the training.
- An iterative design phase (Prototyping phase): in this work, it consisted of two iterations that corresponded to the use of two Learning Design tools and the implementation of possible solutions to support the process

of adoption, with a continuous data collection oriented to formative evaluation aimed at improving the intervention.
- A final evaluation: to conclude on the effectiveness of the solutions proposed.

The case study was carried out in parallel with the teachers' training.

In Figure 6.9 the progression of the case study is represented. After the analysis of the context, two iterations were carried out:

- The first iteration started with the first training phase in the spring of 2017 and ended in November 2018.
- The second iteration started in March 2019 during the second part of the training and ended in December of the same year.

A detailed description of the two iterations is provided in sections 6.8 and 6.9, respectively.

In both iterations, data about needs and barriers were collected through qualitative and quantitative methods which will be described in section 6.7; actions/solutions to support the adoption were identified and tested. The results of the first iteration were analysed and discussed with the participants and solutions were tuned. In the end, I carried out a final evaluation and drew conclusions.

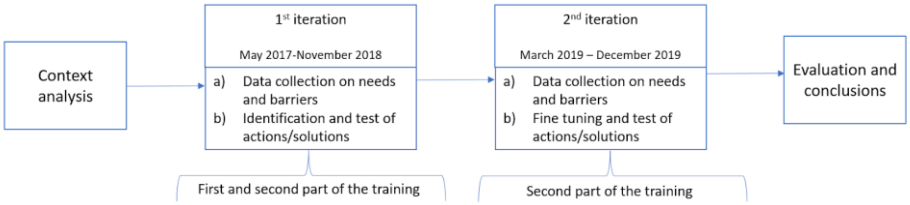

Figure 6.9 - Flow of the case study

6.7 Materials and methods

6.7.1 Participants

A total of 16 teachers participated in the different parts of the training. Indeed, given the length of the training, that covered three school years, the cohort of teachers involved in the case study changed. The initial cohort of teachers was composed of 11 teachers among which only five teachers followed the whole training; three teachers joined the training in November 2017, among which just

one followed most of the training. Two teachers joined the second part of the training. The five teachers who participated in the whole training path have a degree in the subject they teach (two have a scientific background and three in human sciences), two are males and three females, average age is about 40 years, with a short teaching experience between one and eight years, excluding one with 29 years of experience.

6.7.2 Data collection

To organize the process of data collection, I conducted an anticipatory data reduction process (Miles & Huberman, 1994) by creating a schema of "research question – issue – topic".

The research questions that guided the case study were the same of the whole thesis:

RQ1: *What are the factors affecting the adoption of Learning Design methods and tools?*

RQ2: *What actions/solutions can support the adoption of Learning Design methods and tools?*

For each of the research questions I defined issues as conceptual organizers of the research process. For example, as far as RQ1, I identified three issues (corresponding to sub-topics 1.1, 1.2 and 1.3 presented in section 6.5) that were split into more concrete topics to help explore each issue. For issue 1 'What are the needs of the teachers involved in the case study', the topics were: (i) pre-training design practice, (ii) desired features in a Learning Design tool. Finally, each topic was explored through several informative questions which guided the data collection during the case study.

The schemas for RQ1 and RQ2 are reported in Figure 6.10 and Figure 6.11, respectively.

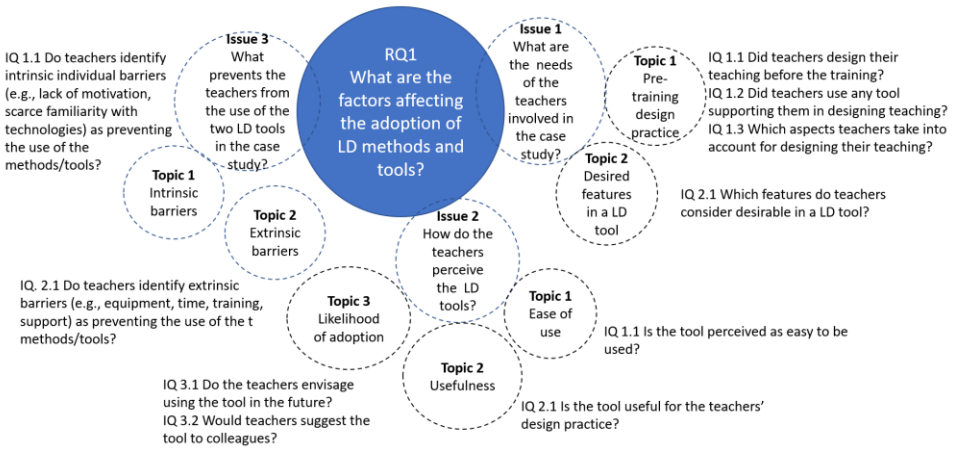

Figure 6.10 - Anticipatory data reduction schema (RQ1)

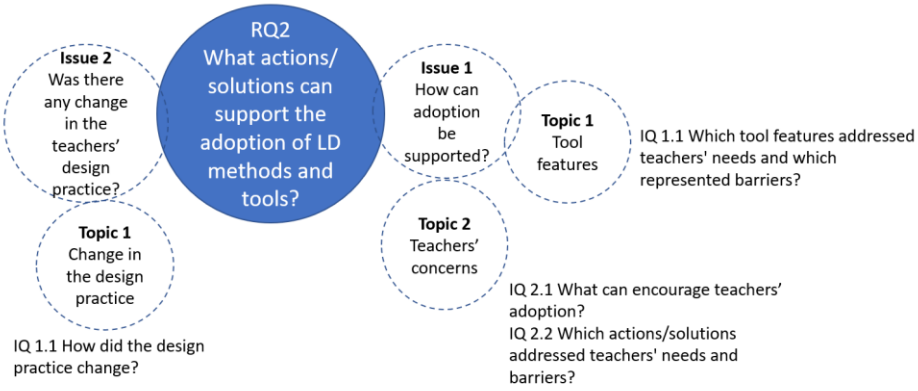

Figure 6.11 - Anticipatory data reduction schema (RQ2)

The data reduction schemas are also presented in text format below.

RQ1: *What are the factors affecting the adoption of Learning Design methods and tools?*

For RQ1, three issues were identified:

Issue 1: What are the needs of the teachers involved in the case study?

The needs were derived exploring two topics:

(T1) Pre-training design practice

Informative questions:

IQ 1.1 Did teachers design their teaching before the training?

IQ 1.2 Did teachers use any tool supporting them in designing teaching?

IQ 1.3 Which aspects teachers take into account for designing their teaching?

(T2) Desired features in a Learning Design tool

Informative question:

IQ 2.1 Which features do the teachers consider desirable in a Learning Design tool?

Issue 2: How do the teachers perceive the two Learning Design tools?

Teachers' perception of the tools was investigated exploring three topics:

(T1) Ease of use

Informative question

IQ 1.1 Is the tool perceived as easy to be used?

(T2) Usefulness

Informative question

IQ 2.1 Is the tool useful for the teachers' design practice?

(T3) Likelihood of adoption

Informative questions:

IQ 3.1 Do the teachers envisage using the tool in the future?

IQ 3.2 Would the teachers suggest the tool to colleagues?

Issue 3: What prevents the teachers from using the two Learning Design methods/tools in the case study?

Barriers to the adoption of Learning Design methods and tools were investigated exploring two topics:

(T1) Intrinsic barriers

Informative question:

IQ 1.1 Do teachers identify intrinsic individual barriers (e.g., lack of motivation, scarce familiarity with technologies) as preventing the use of the methods and tools?

(T2) Extrinsic barriers

Informative question:

IQ 2.1 Do teachers identify extrinsic barriers (e.g., equipment, time, training, support) as preventing the use of the tools/methods?

The three issues focus on the main aspects of the RQ1, exploring both the teachers' needs and the barriers (also implicitly through the teachers' perception of the methods/tools proposed). These issues are further decomposed in topics to better explore each issue. For issue 1, two topics were identified: (T1) the teachers' practice before the training (from which, needs can be derived) and (T2) the features that teachers consider desirable in a Learning Design tool (that could have been explored after the training and again provided hints about needs). For issue 2, three topics are investigated: (T1) ease of use, (T2) usefulness and (T3) likelihood of adoption. These topics provide information for both needs and barriers (as already pointed out in section 6.5). For issue 3, the division between (T1) intrinsic and (T2) extrinsic barriers was maintained and the two topics investigated through two informative questions.

RQ2: What actions/solutions can support the adoption of Learning Design methods and tools?

For RQ2 two Issues were identified:

Issue 1: How can teachers' adoption be supported?

The actions/solutions to reach this goal were explored through two topics:

(T1) Tool features

Informative question:

IQ 1.1 Which tool features addressed teachers' needs and which represented barriers?

(T2) Teachers' concerns

Informative questions:

IQ 2.1 What can encourage teachers' adoption?

IQ 2.2 Which actions/solutions addressed teachers' needs and barriers?

Issue 2: Was there any change in the teachers' design practice?

The issue was explored through one topic:

(T1) Change in the design practice

Informative question:

IQ 1.1 How did the design practice change?

The first issue is clearly linked to the RQ2; two topics were investigated under this issue: (T1) the characteristics of the tools that can be considered, either able to support adoption or to hinder adoption, and (T2) the teachers' concerns that allow to consider more transversal aspects (not linked to the characteristics of the single tools) and identify related solutions. Finally, a second issue was explored, the changes in the design practice.

Data were collected using quantitative and qualitative tools. In Table 6.1, tools adopted for data collection are put in relation with the RQs, issues, and topics they contribute to address.

Table 6.1 - Tools for data collection in relation to RQs (Issues and Topics) and type of data analysis

Research questions (RQ)	*Tool*	*Issue (I)*	*Topic*	*Data analysis*	*Iteration*
RQ1 – factors affecting adoption	Pre-training questionnaire [Q1]	I1 – teachers' needs	T1 – pre-training practice	Qualitative/ quantitative	First
RQ1 – factors affecting adoption	Post-training questionnaire [Q2]	I1 – teachers' needs	T2 – desired features	Qualitative/ quantitative	First
		I2 – tools perception	T1- ease of use T2 - usefulness T3 - likelihood of adoption		
RQ1 – factors affecting adoption	Follow-up questionnaire [Q3]	I1 – teachers' needs I3 – factors preventing the use	T2 – desired features T1 – intrinsic barriers T2 – extrinsic barriers	Qualitative/ quantitative	First
RQ2 – solutions for adoption		I1 – support to adoption	T2 – teachers' concerns		
RQ1 – factors affecting adoption	Designs produced by teachers [D]	I2 - tools perception	T1- ease of use	Qualitative/ quantitative	First and second
RQ2 – solutions for adoption		I1 – support to adoption	T1 - tool features T2 – teachers' concerns		

RQ1 – factors affecting adoption	Reflective diaries [RD]	I2 – tools' perception I3 – factors preventing the use	T1- ease of use T3 – likelihood of adoption T1 – intrinsic barriers T2 – extrinsic barriers	Qualitative	First
RQ1 – factors affecting adoption	Interviews [INT]	I2 – tools perception I3 – factors preventing the use I1 – support to adoption	T1- ease of use T2 - usefulness T3 - likelihood of adoption T1 – intrinsic barriers T2 – extrinsic barriers T1 – tool features T2 – teachers' concerns	Qualitative	First
RQ2 – solutions for adoption		I2 – changes in the design practice	T1 - changes		
RQ1 – factors affecting adoption	End of the training questionnaire [Q4]	I2 – tools perception I3 – factors preventing the use	T1- ease of use T2 - usefulness T3 - likelihood of adoption T1 – intrinsic barriers T2 – extrinsic barriers	Qualitative/ quantitative	Second Second
RQ2 – solutions for adoption		I2 – changes in the design practice	T1- changes		

6.7.3 Description of data collection tools

In this section the tools used for collecting data listed in Table 6.1 are described in detail. I used tools for collecting self-reported data, like questionnaires,

interviews and diaries, but I also used teachers' designs to gather data about the actual use of the Learning Design tools proposed.

6.7.3.1 Questionnaires

Questionnaires were used so as to collect data from the teachers participating in the case study in different moments of the study. Questionnaires are available in Appendix 1. Data collection tools.

- The **Pre-training questionnaire [Q1]** dealt with the teachers' learning design practices before the training. The questionnaire was composed of 17 questions, closed (yes/no, multiple choice, ranking) and open-ended. It was used in the first iteration.
- The **Post-training questionnaire [Q2]** explores the users' perception of the tool (the PP) that has been adopted during the first part of the training in terms of ease of use, usefulness and intention to use. It also explores the capability of the tool to address the eight needs derived from the systematic literature review. The questionnaire includes 21 Likert-scale based questions. It was used in the first iteration.
- The **Follow-up questionnaire [Q3]** aimed to study the actual adoption of the PP after 4 months and the desirable features of a tool for learning design. As far as adoption, the questionnaire explored the barriers to adoption starting from the seven barriers derived from the systematic literature review, moreover it investigated the needs of the teachers starting from the eight needs identified in the systematic literature review. The questionnaire includes 15 closed (multiple choice and Likert scale based) and open-ended questions. It was used in the first iteration.
- **End of the training questionnaire [Q4]** about the use of the two Learning Design tools. The questionnaire investigates the users' perception of Jamboard and the barriers to the adoption of the PP (starting from the 13 barriers identified thanks to the systematic literature review and the Delphi study). The questionnaire includes 29 questions, closed (yes/no, multiple choice, Likert scale based) and open-ended. It was used in the second iteration.

6.7.3.2 Teachers' designs

As explained above, teachers were involved in a design task using the PP. The task entailed a collaborative design of a sequence of activities related to two or

more subjects. Designs were created using the PP in the timeframe of December 2017 to February 2018.

Afterwards, teachers jointly selected a tool (Jamboard), not developed with the specific purpose of designing teaching/learning activities and produced designs during the last session of the training. Designs were produced in groups composed by some of the teachers who followed the training and others who did not.

The designs developed by the teachers (see Appendix 2. Results) were analysed since they reflect the actual use of the proposed tools.

6.7.3.3 Reflective diaries

Teachers were requested to document the design process in terms of decisions taken, time spent, and problems encountered, in a diary. Since for the design activity a distant support was proposed and a course on a Moodle was set up, a specific forum for writing the diary was made available.

The decision to ask teachers to write their reflections on the design task was taken to gather first-hand considerations during the process.

6.7.3.4 Interviews

Interviews were carried out to complement data collected through the other methods and to go more into depth with some topics. The interviews were one-on-one semi-structured interviews; the questions about learning design and the PP were part of a complete interview about the whole training and teachers' future needs.

They were carried out online and were based on visual elicitation (Johnson & Weller, 2001) since they involved the use of selected keywords (presented in slides) that had the goal to introduce the topic (first slide) and trigger the discussion about key issues (second slide). This was done with the goal of letting the respondent free to tackle the issue from his/her point of view and then of driving him/her to discuss other aspects (of course, if one spontaneously grabs the suggestion and starts talking).

In Figure 6.12 an example of the two slides concerning the PP is shown. The first slide (left) introduces the topic, the second one (right) shows some keywords that are used as hints to trigger discussion.

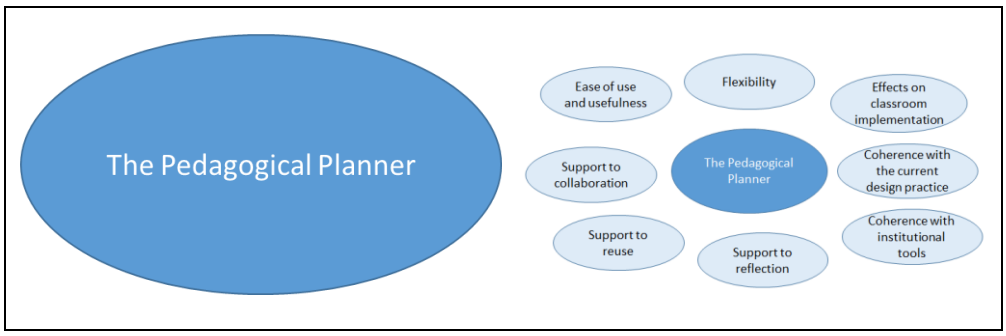

Figure 6.12 - Stimuli used for carrying out the interview

Interview records were transcribed *verbatim*.

6.7.4 Data analysis

Data collected with the above-described tools were analysed as follows:

- **Questionnaires:** data were analysed through SPSS Statistics[6]. Descriptive statistics were calculated for closed questions. Open ended questions were categorized by two coders independently, using an inductive approach, namely creating codes based on the qualitative data itself. In case of different codes, coders found an agreement.
- **Teachers' designs:** they were analysed regarding the use of functionalities made available by the tools and the richness of the paths developed. For example, regarding the PP, teachers were suggested to use a set of selected functionalities in the main menu of the tool (functionalities guiding the conceptualization of the design and the graphical representation of the design). The actual use of the suggested functionalities was commented on.
- **Reflective diaries:** reflective diaries were coded by one coder using an inductive approach, as was done for the answers to open questions. This approach was preferred since teachers were free to write their reflections without any guiding question.
- **Interviews:** data analysis was carried out with an approach called the "framework" method (Gale, Heath, Cameron, Rashid, & Redwood, 2013; Ritchie & Spencer, 1994) that has been developed for large scale social

[6] https://www.ibm.com/products/spss-statistics

policy research. This method belongs to the broad group of qualitative methods, known as thematic analysis (Braun & Clarke, 2006). The method was adopted since it envisages a double approach to analysis: deductive, therefore starting from a set of codes decided 'a priori' and agreed upon by researchers, and inductive, based on emerging codes. This method was considered adequate because the interviews were guided by a set of stimuli, but new contents came up during the interviews. In this specific case, codes were firstly derived from the specific areas of interest explored in the interviews. Other codes emerged from the analysis of the transcriptions. A codebook was prepared (see Appendix 2. Results) and the process of tagging was carried out by two different coders. The two coders are researchers in the field of Technology Enhanced Learning with previous experience in qualitative research. I am one of the two coders, while the second did not participate in the research. A two-step process – individual parallel coding and subsequent negotiation of differences in the generated codes – was carried out. Data were analysed through a software for qualitative data analysis, MAXQDA[7]. Results were organized according to a coding scheme. To check the agreement of the two coders, Cohen's Kappa coefficient (Cohen, 1960) was calculated by the system (agreement between segments) for each interview (see Table 6.2).

Table 6.2 - Coders' agreement (Cohen's Kappa)

Interviews	*K*
Teacher 1	.82
Teacher 2	1
Teacher 3	.84

According to Cohen (McHugh, 2012) the agreement between coders can be considered almost perfect, i.e., above .81.

[7] https://www.maxqda.com/

6.8 First iteration

6.8.1 Description of the first iteration

The first iteration was conducted in parallel with the first part and partially with the second part of the training. The Learning Design tool proposed in this phase was the Pedagogical Planner (see section 6.4.2).

The first iteration was informed by the results of the systematic literature review (see chapter 4): in particular, Table 6.3 shows the correspondence between the needs derived from the systematic literature review and the features embedded in the proposed Learning Design tool (i.e., the Pedagogical Planner).

Table 6.3 - Pedagogical Planner (PP) features and their relation with teachers' needs

Teachers needs derived from SRL	*PP features*
Support to reuse and adaptation of designs	The PP supports reuse and adaptation of designs since it allows to store designs, edit them also after their implementation and make designs available to other teachers online by publishing them
Activate teachers' familiar design thinking	The PP supports explicitly the identification of the main aim of the course and the statement of objectives and competences as teachers do in filling in the design tool proposed by the school
Multiple forms of representation	The PP allows both textual and graphical representation for either conceptualization or authoring. A tool for mind mapping is also embedded in the PP, allowing use of mind maps too
Support cooperation	The PP allows working collaboratively on the same plan by sharing user credentials or registering a new group-user

Moreover, Table 6.4 shows the barriers derived from the systematic literature review and the actions taken to address them (see Chapter 4).

Table 6.4 - Barriers addressed and solutions taken

Barriers derived from systematic literature review	*Actions*
Lack of institutional support	The school principal endorsed the use of the Learning Design method and tool (PP)
Lack of adequate teacher training and long-term support	Teachers were trained on the tool and were offered regular support in the use of the tool in the school year 2017-2018. The training was highly interactive, and the teachers became familiar with the tool during the training
Scarce adoption by peers	All the involved teachers were trained on the same method and tool. To support the use among the trainees, a design task with the tool was given by the trainers
Time issues/workload	Teachers were suggested to use just some functionalities and fill in a limited number of fields of the tool in order to keep the workload limited. In particular, teachers were asked to fill in the Conceptualization area and to draw the graphical representation of the plan

6.8.2 Results of the first iteration

Results of the first iteration were informed by the following data collected from the teachers participating in the training:

- Pre-training questionnaire [Q1]: was filled in by nine teachers at the first session of the training, five of which attended the whole training.
- Post training questionnaire [Q2]: was filled in by 11 teachers and was anonymous.
- Follow up questionnaire [Q3]: was filled in by seven teachers, among whom four participated in the first session of the training and filled in the first part about the adoption of the tool at the time of the follow up, while all the respondents filled in the part related to the desirable features for a Learning Design tool.
- [D1] two designs created by four teachers (three participated in the whole training, one since November 2017).

- [RD] Reflective diary was filled in by two teachers (one participated in the whole training).
- [INT] Interviews were carried out with three teachers selected because those teachers carried out the design task and had the chance to gain a more in-depth experience with the tool.

In Table 6.5 the data collection tools are shown in relation to the participants who filled them in.

Table 6.5 - Data collection tools and teachers (in green the teachers who participated in the whole training)

Teacher	*Pre-training [Q1]*	*Post-training [Q2]*	*Follow-up quest [Q3]*	*Designs [D1]*	*Reflective Diaries [RD]*	*Interviews [INT]*
T1	X	X	X	X	X	X
T2	X	X	X	X		X
T3	X	X	X	X		X
T4	X	X	X			
T5	X	X				
T6	X	X				
T7	X	X				
T8	X	X				
T9	X	X				
T10		X				
T11		X				
T12			X (2nd section)			
T13			X (2nd section)			
T14			X (2nd section)	X	X	

The first two questionnaires, [Q1] and [Q2], were filled in before and right after the end of the first session of the training and this made it possible to collect data from all the participants. In the following months participants changed, some teachers joined the training in November 2017, while others (mainly professionals) were not involved anymore, others did not contribute to the data collection. This caused an uneven distribution of data that, of course, affected the results but, on the other hand, reflects what happens in a long-term training.

Complete results are reported in Appendix 2. Results, while below I report the results under the lens of each issue, topic, or informative question, described in section 6.7.2 and reported in Figure 6.10 and Figure 6.11.

6.8.2.1 RQ1 - What are the factors affecting the adoption of Learning Design methods and tools?

Issue 1 - What are the needs of the teachers involved in the case study?

Topic 1 - Pre-training design practice

Data were collected immediately before the first part of the training started through the **pre-training questionnaire [Q1]** and, therefore, are related to the teachers' practice before the training.

I report here the answers from T1 to T5, i.e., from the five teachers who persisted during the whole longitudinal study (other respondents were excluded) (see Table 6.6).

Four out of the five participants teach the same subject every year; four of them re-design the course every year, and one re-designs the course every three or four months.

As introduced in section 6.4.1, teachers were required from their institution to fill in a template made available online (institutional tool) where they design their teaching at macro level (sequence of the contents to be taught and related abilities, skills and competences) and submit it. Teachers call this 'micro-planning' even though they design their whole course as a sequence of contents.

As it is shown in Table 6.6, that reports the ranking of factors for each teacher, the practice of designing the whole course could have influenced teachers' answers to the question about the aspects they consider when they design a course (or a part of it); indeed, teachers seemed to be guided by the overall goal(s) of the course (three out of five rank it at the first place in the list of the factors affecting the design decisions) followed by 'Learning objectives and competences' ranked at the second place by four out of five teachers.

The national curriculum and evaluation criteria are considered the less relevant factors for the design.

Table 6.6 - Factors affecting teachers' design practice: ranking from 1 to 11

	Teacher	*T1*	*T2*	*T3*	*T4*	*T5*
Ranking	*1*	Goals of the course overall	Goals of the course overall	National Curriculum	Educational approach	Goals of the course overall
	2	Learning objectives and competences	Learning objectives and competences	Learning objectives and competences	Contents of the subject	Learning objectives and competences
	3	Educational approach	Contents of the subject	Goals of the course overall	Reference Learning theory	Reference Learning theory
	4	Reference Learning theory	Educational approach	Learning activities	Learning activities	Contents of the subject
	5	Learning activities	Previous experiences	Contents of the subject	Technologies available	Learning activities
	6	Technologies available	Reference Learning theory	Reference Learning theory	Available resources	Available resources
	7	Available resources	Available resources	Educational approach	Previous experiences	Technologies available
	8	Previous experiences	Technologies available	Previous experiences	Evaluation Criteria	Previous experiences
	9	Contents of the subject	Learning activities	Technologies available	Goals of the course overall	Evaluation Criteria
	10	Evaluation Criteria	Evaluation Criteria	Available resources	Learning objectives and competences	Educational approach
	11	National Curriculum	National Curriculum	Evaluation Criteria	National Curriculum	National Curriculum

This ranking shows that teachers tend to start from goals, objectives and competences and that a tool, to align to their design practice, should help them identify these factors (see also Table 6.3).

Besides the institutional tool for designing the whole course (used by four of them), teachers adopt mainly 'paper and pencil' for designing the daily learning activities (three teachers); just one (T5) stated to adopt a tool that is, actually, a tool for managing presentations (Keynote) and not a tool for Learning Design.

Topic 2 – Desired features in a Learning Design tool

Data were collected immediately after the training with the **post-training questionnaire [Q2]** and in the follow up session with the **follow up questionnaire [Q3].**

In **[Q2]** (11 respondents, anonymous) teachers were required to rate (From 1 'Not at all' to 5 'Very much') the opinions of the teachers about a digital tool (the PP) to manage their designs. Table 6.7 shows the results.

Table 6.7 - Teachers' opinion about the digital format

	Mean	*Sd*	*Min*	*Max*
I think that the opportunity to save my design in digital format could be useful	3.45	1.04	2	5
I think that having a digital version of my design could promote sharing	3.55	1.04	2	5
I think that having a digital version of my design could be useful to revise and change the design over the time	3.64	0.92	2	5

Teachers seem to appreciate that the tool allows them to have a digital version of their designs, and also to share and reuse the designs.

Other data were collected through the **follow up questionnaire [Q3]** (seven respondents). Teachers were asked to express their level of agreement (from 1 'Totally disagree' to 5' Totally agree') as to a list of statements about a Learning Design tool. Results are reported for all the teachers who answered it (seven) in Table 6.8.

Table 6.8 - Desirable features for a Learning Design tool

The tool should...	*Mean*	*Sd*	*Min*	*Max*
Be easy to use	5	0		5
Be flexible	4.9	.4	4	5
Reflect the design culture of the institution (structure and terminology)	4.1	.9	3	5
Support the designer in taking into account all the elements at play (population, context, knowledge domain, etc)	4.3	.8	3	5
Support the designer in the description of the elements at play (population, context, knowledge domain, etc)	4	.8	3	5
Support the graphical representation of the design	3.7	1.4	1	5
Support design revision and change	4.1	.9	3	5
Support reuse and adaptation of my designs	4.7	.5	4	5
Support reuse and adaptation of designs from others	4.4	.5	4	5
Support collaboration among colleagues	4.6	.5	4	5
Allow me to save time	4.9	.4	4	5

'Easy to use' got the maximum rate (5), followed by the capability of the tool to make the teacher save time and the tool flexibility (4.9). A high rate was also achieved by the capability of a tool to support reuse and adaptation (4.7).

The lowest rates were obtained by 'Support the graphical representation of the design' (3.7), 'Reflect the design culture of the institution (structure and terminology)' and 'Support design revision and change' (4.1).

Teachers did not add any other need.

Issue 2 - How do the teachers perceive the PP tool?

Teachers' perception of the tool (and the related topics: ease of use, usefulness and likelihood of adoption) was derived from the analysis of the designs produced, the follow up questionnaire [Q2] (anonymous, answered by 11 teachers), the reflective diary and the interviews (see Appendix 2. Results).

As far as the designs, I describe them here to have a single reference point. Teachers were told to fill in details in the Conceptualization area and to draw the sequence of activities in the Authoring area. They were let free to describe each activity in the sequence to the level of detail they considered useful. The designs were analysed by me according to the following criteria: 1) completeness (fields that are filled in); 2) number of activities envisaged; 3) articulations of the path (presence of different kinds of activities, parallel paths for different students, etc.). The analysis of the designs (see Appendix 2. Results) shows the following situation.

Design A (prepared by T1 and T14) misses some of the descriptions required in the Conceptualization area (contents, educational objectives of the design - including knowledge, abilities and competences - and tools and resources to be adopted). Therefore, the Conceptualization area was incomplete. Regarding the Authoring area, teachers created a flow of five activities (with parallel paths) and kept the description of the single activities at a shallow level.

Design B (prepared by T2 and T3) was complete as to the Conceptualization section; similarly, to Design A, in the Authoring area teachers created the flow of activities and kept the description of the single activities at a general level (no details about objectives, organisation of the work, etc). The path was composed of three activities.

Topic 1 – Ease of use

In the evaluation after the first session of training (**post training questionnaire [Q2]**, 11 respondents), teachers were asked to state their level of agreement (From 1 'Not at all' to 5 'Very much') about a list of statements related to the ease of use of the tool (the PP).

Results are reported in Table 6.9.

The tool got evaluations around the midpoint of the scale for almost all the items included in the category 'Ease of Use'. Values are slightly above for ease of use (3.27) and flexibility (3.36) and slightly below as to time saving (2.36), design simplification (2.64) and engagement (2.73).

Regarding the **designs** by the teachers, as mentioned above, one of the projects lacks the required information in the Conceptualization area (Design A, T1 and 14), but the path is long and articulate, while the second (Design B, T2 and T3) includes all the required information but it is short and linear. To understand

the reasons behind these patterns of use, I crossed these data with the reflective diary and the interviews.

Table 6.9 - Teachers' opinions about of the easiness of use of the tool

	Mean	*Sd*	*Min*	*Max*
The tool is easy to be used	3.27	.90	2	5
The tool is engaging	2.73	.79	1	4
The tool is flexible	3.36	1.12	1	5
The tool makes the design process easier	2.64	1.12	1	5
The tool allows to save time	2.36	1.21	1	5

Unfortunately, teachers' comments in the **reflective diary** were short and not very informative. Only two teachers (authors of Design A) compiled the diary after the design task. Comments were negative and focused on time issues, the tool was considered complex and time consuming.

In the same line the results of the **interviews**; the tool was considered by the three teachers interviewed time consuming and not user friendly; one of them complained about the lack of support at level of graphical interface as it is illustrated in this excerpt:

"I realize that the ultimate 'user friendly' doesn't exist...it [the PP] has to be stuff you understand on the fly, very graphic… and then there's the graphics...as I realize here [at the vocational training institute] with those who work on it, doing graphic work requires minds to pass a concept quickly. Certainly, there is some lack of the graphic aspect in the PP, which allows you to understand on the fly, then there are programming limitations". (T1)

The authors of the Design B, complained mainly about the difficulties met in using the tool:

"It really takes a huge amount of time, I struggle, […] you pass preparing these schemas three times the time you spend in class. I tell honestly… I don't". (T2)

"Cumbersome, as it's not user-friendly, fields are in different pages, so I have to go and pick up […]. The colleague and I spent five hours going back to where we were and often we were wrong, we closed the windows in the wrong way ... we didn't reopen in the right way ... I mean, it was a remarkable botch ... and since I was at the PC I know well how much effort it took [Laughs]. Probably it is a matter of practice, maybe with constant use a person acquires practice". (T3)

Topic 2 – Usefulness

As for ease of use, in the evaluation after the first session of training (**post training questionnaire [Q2],** 11 respondents), teachers were asked to state their level of agreement (From 1 'Not at all' to 5 'Very much') regarding a list of statements about the usefulness of the tool. Results are reported in Table 6.10.

Table 6.10 - Perceived usefulness of the PP and its functionalities

	Mean	*Sd*	*Min*	*Max*
The tool is useful	3	.89	2	5
The tool supported the conceptualization of new (collaborative) activities	3.09	1.14	1	4
The tool allows to effectively represent the pedagogical path	3.18	.75	2	4
The tool helped considering the elements at play (context, population)	3.64	.92	2	5
The possibility to describe (in text format) the different elements is useful	3	1.34	1	5
The graphical representation of the activity flow is useful	3.18	.98	1	4
The possibility to describe (in text format) the activities is useful	2.91	1.14	1	4
The tool supported self-reflection	3.27	1.01	1	4
The tool promoted discussion and sharing among colleagues	3.64	1.21	1	5
The section about self-regulation helped me in reflecting about how to improve self-regulated learning in my students	3.45	1.37	1	5

Teachers expressed a level of agreement beyond the midpoint of the scale (3) for the most part of the statements. The highest levels of agreement were given about its capability of helping the teachers considering all the elements at play in designing learning (3.64) and its capability to promote the discussion and sharing among the colleagues (3.64); the lowest is related to the possibility to describe the activities in text format (2.91).

As far as **designs**, again I cross-referenced information from designs with interviews, while teachers did not mention aspects related to the usefulness of the PP in the reflective diary.

The feedback collected through **interviews** was mainly negative (see Appendix 2. Results).

Two out of three teachers stated that using the tool for designing did not affect implementation, while the third was more positive. Asked about the guidance provided by the tool in taking into account the different aspects at play (population, context, etc.) and its impact in carrying out the lessons one teacher answered:

"Being forced to think about all the parameters involved, in my opinion everyone was helped. There we plan lessons more effectively, surely". (T3)

As to the alignment with teachers' design practice, answers vary a lot from one teacher to another; the tool was considered partially aligned with his/her practice by Teacher 3, not aligned by Teacher 2, while Teacher 1 stated that he/she usually designs differently but concluded that he/she became aware of the advantages of considering the aspects highlighted by the PP and the related method:

"I do it in another way but now that the flash of the whole description of the class comes to mind, I realize that those variables are important to have in mind; this tool put them there, imposed them on us, made them present to us every time". (T1)

Teachers did not consider that the tool specifically supports reflection. Two out of the three stated that they did not come back to the design to reflect on it; one of them said that it might support reflection, but the same can be said for a design sketched on a piece of paper. The other highlighted that reflection should emerge from the collaboration with colleagues. The same is said for the support to reuse; all the teachers did not recognize the tool as an added value in this sense. None of them reused the design produced and again one teacher stated that also a design drafted on a piece of paper can be reused by the teacher who created it:

"Sure, but my sheets too…I have a paper archive from the 70s/80s with plastic sheets, I put inside it what is my planning with a photocopy of the necessary resources or the link of the resource online required". (T3)

Moreover, teachers expressed doubts about the capability of the tool to support collaboration with their colleagues for two reasons. The first one was related to the tool itself; the PP was considered too complex to collaborate using it. The second was related to teachers and their attitude towards collaboration. According to the interviewees, teachers in their school do not collaborate and the introduction of the tool is not sufficient to change the situation. On the other hand, one of them, during the interview, recognized a potential benefit of using it to collaborate with other colleagues, outside the institution:

"But you broaden my horizon, also thinking outside the institution in which I work, if the PP allows me to share or access interventions of other teachers who upload them, this is interesting […]". (T1)

Two more aspects can be linked to the tool's usefulness. One teacher considers the tool (and the design method) not adequate to the context; according to him/her the context is not comparable to a more traditional one, since lesson implementation often implies changes on the fly due to changes in the calendar, frequent interruptions, and students' misbehaviour.

The only positive consideration is referred more to the method than to the tool; indeed, one teacher appreciated the capability of the tool to provide guidelines in the process of designing:

"I saw it more as a guide: remember that the class is like this, remember that there is a first phase in which you do this, remember that there are dynamics that can be set, that there is a final phase…". (T1)

Teacher 1 appeared to be more positive, especially as far as the method; this might be because he/she got a bachelor's degree in teacher education and is probably more aware of the importance of designing learning activities.

Topic 3 – Likelihood of adoption

The likelihood of adoption of the tool was explored after the first session of training (**post training questionnaire [Q2],** 11 respondents). Again, teachers were asked to state their level of agreement (From 1 'Not at all' to 5 'Very much') in relation to two statements.

The two statements were rated below the midpoint of the scale (3) showing a limited intention of adopting the tool and a scarce confidence in the usefulness of the tool for their colleagues. Data are reported in Table 6.11

Table 6.11 - Likelihood of adoption

	Mean	*Sd*	*Min*	*Max*
I think that in the future I will use the PP for designing collaborative activities	2.64	1.03	1	4
I think that the PP could be useful for my colleagues to design	2.81	.98	1	4

The feedback collected through **interviews** was in line with the above-mentioned evaluation: teachers did not express the intention to adopt the tool spontaneously. The institution was cited by two of them as having a role in the adoption. In particular, teachers highlighted that they would have adopted the tool only if it was considered mandatory by the institution (that was not the case).

"Let's say, if the institution asks us to use this tool one takes some time [INT: sure] otherwise I take what I can steal from the PP and I put it in… I organize it in a Google doc..., I link it to the lesson ... It's like this". (T1)

"The PP can be useful for planning, but I won't hide the fact that even I, who am the most dutiful…, they told me to use it and I used it...then I couldn't be steady…". (T3)

Issue 3 - What prevents the teachers from the use of the PP Learning Design tool?

Topic 1 and 2 – Intrinsic and extrinsic barriers

In the **follow up questionnaire [Q3]** (seven respondents) teachers were asked to identify the aspects that had represented a barrier to the adoption of the tool (PP) for designing educational paths. Teachers were presented with a list of seven predefined options plus the "Other" option and were asked to select three as a maximum. Results are presented hereunder:

- My institution does not support the tool adoption
- Very few (or no one) of my colleagues use it (three respondents)
- The training on the tool was insufficient (two respondents)
- The tool is too complex (one respondent)
- I make little use of technologies in my teaching practice
- Lack of time (two respondents)
- I'm not motivated to use it (one respondent).

The most selected option was the 'scarce adoption by colleagues' followed by the 'insufficient training on the tool' and 'time constraints'.

Asked to provide reasons for their answers, teachers motivated mainly the issue of 'time constraints', claiming that they did not have enough time for designing teaching.

"Our time is short, and we can't dedicate adequate time to designing our lessons".

"The radical change of the school organization [namely the transition from the traditional classroom organization to the 'disciplinary laboratory classroom' model] required a considerable daily effort and has stolen energy to design teaching".

"Lack of motivation of the teachers, due to the organization of work".

Only two teachers (the authors of the Design A, see Appendix 2. Results) explained the reasons behind the partial use of the tool in the **reflective diary**, describing what prevented them from using the tool:

- Time/workload: teachers declared they had to design the learning path during Christmas holidays since they did not have dedicated time during their regular activity to the task.
- Tool complexity: the time required to design the learning path was considered huge since they were not familiar with the tool that was considered complex and with technical problems.

The first point can also reflect the lack of real institutional support since, while the responsible was aware of the given task, teachers were not given the time to design the activity during the previous school months.

Interviews were focused on the tool perception, nevertheless the most important issues regarding adoption can be inferred from the answers of the teachers. The prevailing topic was the time required for using the tool.

"It [filling in the fields of the PP] really takes a huge amount of time, I struggle, […] you [the teacher] pass preparing these schemas three times as long as the time you pass in class. I tell honestly… I don't". (T2)

This can be put in relation with the time constraint and the complexity of the tool (extrinsic barriers).

Teachers were not motivated (intrinsic barrier) to adopt the tool since they do not perceive it as useful; for example, teachers reported that they do not collaborate, therefore the features of the PP supporting reflection and collaboration are not of interest for these teachers.

"Then, perhaps the thing the PP wanted to do is to get colleagues to collaborate. But I doubted about virtual/digital collaboration [...] Given the digital tool and since there is no real material collaboration before, in the absence of that one, the tool in my opinion is not

usable". (T1)

The new organization ('disciplinary laboratory classroom') seems not to favour sharing and collaboration.

"The only thing is that, in my opinion, we [teachers] have very few opportunities to meet. Whereas before, as we went from one class to another, we exchanged opinions -- the times have always been very short, so we also take advantage of these moments for exchanges and evaluations -- now we don't meet anymore because everyone remains in their classrooms, it's a bit more difficult". (T2)

6.8.2.2 RQ2 - What actions/solutions can support the adoption of Learning Design methods and tools?

Issue 1 - How can adoption be supported?

Topic 1 and Topic 2 - Tool features and Teachers' concerns

Although teachers were not required to suggest possible solutions oriented to support adoption, such solutions might be inferred from the **follow up questionnaire [Q3]**, the developed **designs** and the **interviews**.

For example, as far as the tool features, in the **follow up questionnaire [Q3]** (seven respondents) when asked what can encourage them to adopt the tool, teachers answered as follows:

- Concrete examples of plans in my discipline (two respondents)
- Greater flexibility, easiness of use
- Colleagues' adoption (design sharing).

These suggestions might be interpreted as solutions to overcome barriers, in terms of characteristics of tools (providing flexible and easy to be used tools) and aspects not linked to the specific tool (such as providing concrete examples of plans and supporting the adoption among colleagues).

The analysis of the **designs** produced by the two dyads and the **interviews** confirmed that usability is a really important aspect and that the tool should be easy to use and user-friendly. Moreover, the tool should be better aligned with teachers' design practices, for example teachers did not feel the need to fill in all the fields of the PP since they did not consider it useful for designing an activity for themselves. In addition, in contrast to what stated in Q3, these teachers de-

clared they do not actively collaborate with colleagues and do not come back to revise their designs.

Issue 2 - Was there any change in the teachers' design practice?

Topic 1 - Change in the design practice

In the **interviews** the three teachers were asked about their design practices at the end of the first iteration.

One of the interviewees (T2) referred only to the planning required by the school, therefore he/she did not change anything; Teacher 1 identified two levels, the planning required from the school and the daily design, saying that often he/she tries to match ideas of transversal activities (like the school newspaper) with the contents envisaged in the microplanning. The remaining interviewee (T3) described a sort of template that he/she usually adopts for organizing the single lessons, that he/she attributes to the method delivered through the PP but that reflects more a canvas for carrying out a collaborative activity. In her template she divides the lesson (two hours) in time blocks: introduction (10/15 minutes), collaborative work (40 minutes), break (5 minutes), group work (25/30 minutes) and a last plenary session (25 minutes).

Despite the training, teachers did not increase practice sharing both in the school context and outside (with colleagues teaching in other schools). One of them during the interviews started thinking about practice sharing not only in relation to the colleagues of the same school but also outside the institution.

6.9 Second iteration

6.9.1 Description of the second iteration

The second iteration was conducted in parallel with the second part of the training (see Figure 6.9). The Learning Design tool proposed in this phase was Jamboard (see section 6.4.3). This time the tool was not proposed by the trainers but was proposed by one of the trainees and agreed upon by the others.

This iteration was informed partially by the systematic literature review, partially by the Delphi study and partially by the results of the first iteration.

In particular, Table 6.12 contains the relations between teachers' needs derived from the systematic literature review and the first iteration and the features offered by Jamboard.

Table 6.12 - Jamboard features and their relationship with teachers' needs

Teachers' needs derived from systematic review and first iteration	*Jamboard features*
Ease of use	The tool (Jamboard) has an easy interface since it is based on a bar on the left of the screen through which the user acts on the board
Flexibility	The tool (Jamboard) is a whiteboard without a predefined structure. The tool can be used from different devices (tablet, PC, whiteboard)
Time saving	The tool (Jamboard) allows to embed resources to be used for the delivery of the lesson
Support reuse and adaptation of the teacher designs	The tool (Jamboard) allows to store and edit files
Support reuse and adaptation of other teachers' designs	The tool (Jamboard) allows to store and edit files in a shared folder
Coherence with the teachers' design thinking	The tool (Jamboard) can support any kind of design process since it does not have any predefined structure

As detailed in Table 6.12, the tool addresses the needs expressed by the teachers in the first iteration (see Table 6.8). The tool is easy to use because it has an easy interface and allows simple actions. As far as flexibility, the tool does not have a predefined structure, a quality that make it similar to a piece of paper that is apparently the support on which teachers occasionally design; as said above, the tool does not provide any guidance, but - in this case - teachers were already trained about the main elements to take into account while designing. Another need that was stressed by the teachers in the first iteration is that a design tool should allow them to save time, this can be considered the case of this tool that is easy to use and allows embedding resources that can be used to deliver lessons. Other two needs are related to reuse and adaptation of their own or other teachers' designs, that the tool can address since it allows the user to store and edit files in personal and shared folders. Finally, the tool aligned with the teachers' design practices since it allows them to follow their usual one.

Table 6.13 shows the barriers that could be addressed using Jamboard.

As presented in the dedicated section (section 6.8.2.1) one of the most cited barriers is time/workload. As mentioned above, the tool is really easy to learn and then use, and it can be also used to embed resources useful for the lesson. Another positive aspect of the tool is its reduced complexity, which may have a positive impact on the time/workload required to carry out the design process. The adop-

tion by peers might be supported by the fact that the tool was proposed by one teacher and agreed with colleagues during the reflective meeting.

Table 6.13 - Barriers addressed and solutions taken

Barriers derived from systematic review and first iteration	*Actions*
Lack of institutional support	The institution kept endorsing the training
Conceptual complexity of methods and tools	The tool (Jamboard) has an easy interface
Scarce adoption by peers	The tool (Jamboard) was proposed by a teacher and its use agreed by colleagues (see description in section 6.4.2), this might increase the chances that the tool is used
Time/workload	The tool (Jamboard) allows to embed resources and can be adopted for the delivery of the lesson, since it can be used as an interactive whiteboard

Moreover, some of the experts' suggestions deriving from the Delphi study (see chapter 5) were implemented (see Table 6.14).

Table 6.14 - Suggestions derived from the Delphi study and solutions taken

Experts' suggestions	*Solutions*
Institutional involvement in training	The delegate of the director participated in the reflective meeting and was informed in the following months
Active involvement of teachers in the tool development	Teachers were helped to agree on the use of an already existing tool during a reflective meeting
Alignment between tools and teachers' (and institutions) needs/practice	Teachers' needs were collected, and a tool potentially aligned with their needs was identified with them

6.9.2 Results of the second iteration

Results of the second iteration were informed by the following data collected from the teachers participating in the training:

- [D2] nine designs created by 10 teachers

• [Q4] End of the training questionnaire filled in by seven teachers about the use of the two design tools and methods.

In Table 6.15 the data collection tools used are shown in relation to the participants who filled them in.

Table 6.15 - Data collection tools and teachers

Teacher	*Designs [D2]*	*End of the training [Q4]*
T1	X	X
T2	X	X
T3	X	
T4	X	X
T5	X	X
T6		
T7		
T8		
T9		
T10		
T11		
T12	X	
T13	X	X
T14	X	X
T15	X	X
T16	X	

6.9.2.1 RQ1 - What are the factors affecting the adoption of Learning Design methods and tools?

Issue 2 - How do the teachers perceive the Jamboard tool?

Data about ease of use, usefulness and likelihood of adoption of the tool were collected through the **end of the training questionnaire [Q4]** (seven respondents) that was delivered in February 2020 (4 months after the last session) and were cross-referenced with the designs. **Designs** produced using Jamboard (available in Appendix 2. Results) were created during one single lesson of the training (one hour and half after an introduction). Teachers familiarized themselves very quickly with the tool and were able to complete the task in the given time.

The instruction for the task was to create a design, individually or in pairs, for the subject(s) taught, following the usual design practice (that could be influenced from the training or not). The resulting designs show different design practices.

Three designs were more structured and reflect somewhat the method proposed through the PP. In these three designs ('Mock-up space' created by T15 and T1, 'More or less space' by T4, and 'Space IRC (Religion)' created by T16), different elements are present (e.g., the description of the context and the population involved, the objectives of the activity, the set-up of the classroom, resources for the activity and evaluation criteria). Although T16 did not participate in the first part of the training about the PP, but just in the second cycle, he/she was found to design according to the method proposed through the PP.

The other designs focus more on specific aspects. A major part of the designs just mentions (but do not describe) the context and describe the steps of a single activity ('It's better healthy space' by T2, 'Hands in dough' by T12, and 'Personalized space' by T13) or describe the steps of single activity without any contextualization ('Tell me space' by T5). One teacher focuses on context and contents ('Easy Space' by T3). A last teacher oriented the design to the delivery of the activity, embedding resources for students in the design ('It's about time space' by T14).

Topic 1 – Ease of use

As shown in Table 6.16 even though the teachers were able to produce their designs in a few hours, the tool got evaluations below the midpoint of the scale for almost all the items included in the group 'Easiness of use'. Just the item 'the tool is easy to be used' obtained a mean evaluation above the midpoint (3.2). The tool is not considered particularly flexible (2.8) despite it being almost a blank canvas, it does not seem to make the design process easier (1.8) or to help the teachers save time (1.6).

Table 6.16 - Easiness of use

	Mean	*Sd*	*Min*	*Max*
The tool is easy to be used	3.2	.84	2	4
The tool is engaging	2.2	.45	2	3
The tool is flexible	2.8	.84	2	4
The tool makes the design process easier	1.8	.84	1	3
The tool allows to save time	1.6	.89	1	3

Topic 2 – Usefulness

Questions about usefulness were adapted to the functionalities of the tool (see Table 6.17).

The tool got evaluations far below the midpoint of the scale for almost all the items exploring Usefulness. It was considered not able to support the different aspects of the design, i.e., conceptualization of collaborative activities (1.8), the representation of the learning path (2), the possibility to represent in text and images format the path (2.2). Teachers do not think that the tool can help considering all the elements at play in the design (2) and that it could be able to support design sharing (2.5) and reusing (1.75). Finally, it is considered not coherent with their design thinking (2.2), which is quite surprising since the same teachers declared to design their teaching on paper and pencil. The functionality that got the highest rate is the possibility to import files (2.6).

Topic 3 – Likelihood of adoption

Six out of seven teachers declared they never used Jamboard, except for carrying out the design activity during the training.

According to Table 6.18, teachers do not think that they will use Jamboard for designing (1.6) but appear more positive as to the usefulness for other teachers (2.4).

Table 6.17 - Usefulness

	Mean	*Sd*	*Min*	*Max*
The tool was useful	2	1	1	3
The tool supported the conceptualization of new (collaborative) activities	1.8	.84	1	3
The tool allowed to effectively represent the learning path	2	1.22	1	4
The tool helped considering the elements at play (context, population)	2	1.22	1	4
The possibility to describe (in text format) the different elements was useful	2.2	1.30	1	4
The possibility to graphically represent the design was useful	2	.71	1	3
The possibility to import files was useful	2.6	1.34	1	4
The tool supported self-reflection	2	1.22	1	4
The tool promoted discussion and sharing among colleagues	2.5	1.29	1	4
The tool supported reuse and adaptation	1.75	.50	1	2
The tool was coherent with the teacher design thinking	2.2	1.10	1	4

Table 6.18 - Likelihood of adoption

	Mean	*Sd*	*Min*	*Max*
I think that in the future I will use Jamboard for designing teaching/learning activities	1.6	.55	1	2
I think that Jamboard could be useful for my colleagues in the future for designing teaching activities	2.4	1.14	1	4

Teachers were, finally, required to point out two positive and two negative adjectives about Jamboard.

Hereunder the positive adjectives:

- *"It eases communication"*. (T4)
- *"Make the whole path more visible"*. (T13)
- *"It is integrated in GSuite that we already use"*. (T1)
- *"Graphics"*. (T4)
- *"Greater design sharing with colleagues"*. (T13)
- *"Online collaboration in real time"*. (T1)
- *"Collaborative"*. (T15)
- *"Intuitive"*. (T15)

As far as the positive adjectives, three teachers highlight the support to collaboration and sharing, one cites more generally communication. One teacher focuses on the representation allowed by the tool: the fact that it makes the path more visible. The other comments are related to aspects that can facilitate the use of the tool like the fact that it is intuitive, that it is integrated in a platform that teachers already use, and the graphics.

The negative adjectives are the following:

- *"Padlet has more functionalities"*. (T4)
- *"For the kind of design required by the Institution for my subject can be hardly usable"*. (T13)
- *"The tool is not designed for this purpose: it has not a structure that suggest the steps to be taken"*. (T1)
- *"It requires a use of technologies that I usually don't do"*. (T13)
- *"It would be convenient with the Jamboard (Google whiteboard)"*. (T1)
- *"Messy"*. (T15)
- *"Limiting, due the absence of superstructure"*. (T15)

A couple of comments refer to the absence of a structure guiding the teacher in the design, one stating that the tool is confusing. Two comments point out that the tool is not suitable in relation to the school requests and the teacher's use of technology.

Issue 3 – What prevents the teachers from the use of the PP Learning Design tool?

Topic 1 and 2 – Intrinsic and extrinsic barriers

In the **end of the training questionnaire [Q4]** I came back to asking the reasons behind the lack of adoption of the PP. This way, I aimed to understand the barriers detected by the teachers in the long term; the questionnaire included the alternatives proposed in the follow up questionnaire [Q3] and the barriers derived from the Delphi study (see 5.3.3).

Teachers were presented with a list in which they could select three alternatives as a maximum, the most significant ones in their opinion (see Table 6.19).

Table 6.19 - Barriers to the PP adoption

Barrier	*N° of respondents*
Lack of institutional support	/
Lack of adequate training	/
Scarce adoption by colleagues	1
Conceptual complexity of the tool	2
Scarce use of ICTs in the teaching practice	1
Time/workload aspects	5
Lack of motivation	2
Scarce adherence to my needs/practice	2
Scarce adaptability of the tools to the context/curriculum	/
Lack of confidence with technology	1
Lack of creativity	1
Negative attitudes of students towards TEL approaches	/
Lack of support to orchestration (including maintenance and help desk of deployed designs)	/

Teachers agree on one barrier (highest frequency), 'Time/Workload factors' (5), followed by 'Scarce adherence to my needs/practice' (2), 'Lack of motivation' (2) and 'Conceptual complexity of the tool' (2).

Comparing these results to the results of the **follow up questionnaire [Q3]** of the first iteration, it can be noted that respondents did not select the alternatives about the lack of adoption by peers and the adequacy of the training in the **end of the training questionnaire [Q4]**, while time/workload, the complexity of the tool, and lack of motivation were mentioned. Unfortunately, the differences in the two groups of respondents limit the possibility to draw conclusions.

Teachers were not asked about the barriers to the adoption of Jamboard since they used it just during a short training session.

6.9.2.2 RQ2 - What actions/solutions can support the adoption of Learning Design methods and tools?

Issue 2 - Was there any change in the teachers' design practice?

Topic 1 - Change in the design practice

A specific question on "Changes in the design practice" was explicitly posed in the **end of the training questionnaire [Q4]** whose questions investigate the impact of both iterations.

Teachers were asked whether the whole training brought any change in their practice and according to their answers:

- Five out of seven teachers declared that the training brought a change in their design practice
- Two did not answer the question

When asked to motivate their answers, they responded as follows:

"It improved the setup of the learning design". (T4)

"I tried to apply the knowledge acquired during the course". (T2)

"It provided me with a scientific basis on teaching that I felt was only experiential and poorly reasoned. I am aware that I still do not use and master most of the training tools/ approaches/indications, but I am aware of them". (T1)

"It helped in creating an order that was absent before". (T5)

"Greater attention to design". (T15)

One of the two teachers who did not answer, commented:

"Since I haven't participated in the whole course, I can't say to what extent it changed my design practice… I usually consider some suggested aspects, others represented a starting point". (T13)

In another question, teachers were asked about the design approach learnt during the training that was proposed through the PP. In particular, if they have adopted this approach or some aspects of the approach (e.g., the description of the elements - context, population, etc. - that influence the design, the lesson sequencing, etc.) even without using the tool:

- Five out of seven teachers answered that they did not adopt the approach or aspects of it.
- One did not answer.

- One answered ‘YES’ and indicated how the approach influenced his/her design practice as follows: 1) design the teaching and learning activities more systematically and 2) draft the design on paper.

Curiously, this answer was given by T15, who did not attend the training from the very beginning. T15 did not use the PP for designing an activity but participated in the other sessions of the training during which the discourse on Learning Design was not the focus but was continuously recalled.

When asked to motivate their answers, they responded as follows:

“The approach is demanding in terms of time, we cannot afford it”. (T4)

“I conceive what I have to do in relation to the objectives to achieve, but I don't make a pedagogical planner-like description”. (T2)

“I did not adopt the tool in my practice. To be honest, due to my practice, the laboratory nature of my subject and the different fronts in which I am engaged, I find it very difficult to dedicate time to such a detailed planning of my training intervention”. (T1)

“Time issues”. (T5)

Finally, teachers were asked if they see any advantage, in adopting the PP:

- Three out of seven answered that they do not see any advantage
- Two answered ‘YES’
- One didn’t know
- One did not answer

When asked to motivate their answers, teachers responded as follows:

“I find it difficult to apply. Compiling it is demanding (no advantages)” (T2)

“It would help me formalise my intervention (advantages)”. (T1)

“It would allow to better personalize lessons (advantages)”. (T5)

6.10 Discussion

This case study had the objective of studying the uptake of learning design methods and tools in a cohort of teachers that were involved in a long-term blended training. During the training, I implemented and tested solutions derived from

the analysis of the literature (systematic literature review) and the data coming from experts (Delphi study) and the participants themselves.

The research was carried out in two iterations corresponding to the introduction of two tools; the first one is a tool designed for supporting the process of Learning Design and providing guidance, the second was identified by the teachers themselves and is not a tool created on purpose for Learning Design. Nevertheless, the latter tool can be considered the digital version of what the teachers declared they use for designing (a piece of paper).

6.10.1 RQ1 - Factors affecting the adoption

6.10.1.1 Issue 1 - Needs of the teachers involved in the case study

Teachers involved in the case study are required to design every year their whole course (macro-design) through a tool made available by the school, while they are not required to design the daily activities. In the **pre-training questionnaire [Q1],** some of the teachers declared to take notes on paper. This practice was confirmed, afterwards, in the interviews, by two of the respondents, while the third stated not to make his/her design explicit in any format.

When asked about the desirable features for a Learning Design tool [in **Q3**], I noted that all the features proposed (derived from the literature review, see section 4.3.1) were rated above the midpoint of the scale. Ease of use proved to be the most valued aspect for a tool, as well as the capability of the tool to allow the teacher to save time and its flexibility. These three needs got the highest rates also by experts in the Delphi study (see section 5.3.3) showing a common vision of experts and teachers.

The evidence from the interviews suggested that the teachers do not share their designs with colleagues and that they tend to reuse their designs as they are; therefore, needs related to sharing and reusing that were positively rated in the **follow-up questionnaire [Q3]** apparently do not reflect the actual practice of the teachers. This can partially explain why these teachers are not motivated to adopt a digital tool for designing their learning activities: in this cohort of teachers, Learning Design (when it is done) is an individual activity.

Finally, the process of designing learning activities was affected by the training in some aspects, as we will see in the following sections, but the medium remained the paper.

6.10.1.2 Issue 2 - Perception of tools

Perception of tools was investigated in order to evaluate the role of the characteristics of the tools in the adoption, in relation to teachers' needs.

As to the PP, the impressions gathered immediately after the training (**post training questionnaire [Q2]**) show that teachers expressed a neither positive nor negative evaluation of the tool, and low intention to adopt it. After the design task (carried out between December 2017 and February 2018) the teachers' perception was more negative. The main issue raised was the complexity of the tool, from the technical viewpoint. The tool was considered not user friendly, and teachers reported that designing with it requires a lot of time and effort. Thus, the tool does not correspond to one of the needs highlighted in the literature (see sections 4.3.1) and expressed by the teachers themselves: ease of use.

As to its usefulness, teachers seem to positively value the guidance provided by the tool. Teachers highlighted its capability of helping them consider all the elements at play in designing for learning; this statement was expressed both in the initial questionnaire and by one teacher in the **interviews**. The capability of a tool to provide guidance and being at the same time flexible is valued in Learning Design tools (Bennettet al., 2015; Laurillard et al., 2013; Masterman & Manton, 2011). Other explored aspects which derive from the analysis of the literature (like the capability to promote the discussion and sharing among the colleagues, to promote self-reflection or the possibility to store a digital version of the designs to come back to them) were positively valued in the first questionnaire, but in **interviews** these affordances did not turn out to be useful for this specific cohort of teachers. This was explained by the teachers due to the lack of time to dedicate to the design activities, but - as said in the previous section - it is quite evident that this group of teachers seldom share their designs and reflect on their implementation. In the same line, Albó and Hernández-Leo (2018) report that teachers expressed a positive general opinion about the tool they were developing but most of them recognized that design could be difficult for them because of lack of time.

As early as the **post training questionnaire [Q2]** teachers expressed a low intention to adopt the PP in their practice and they did not think that it could be useful for their colleagues. The reasons put forward are related mainly with time/workload issues, confirming the perception expressed in the first set of questions about the lack of capability of the tool to help them save time. This was also confirmed in the **interviews,** where teachers highlighted that they would have adopted the tool only in case the institution had asked for it.

Despite these premises, the tool got a higher evaluation than the second one, i.e., Jamboard, even if this latter tool was proposed by the teachers themselves. Jamboard was considered slightly easier to use but, despite this, the tool was not considered able to help them save time. Similarly, it was not considered useful or

able to guide the design process. For this reason, teachers expressed a very low intention to adopt it. The results of the comparison of the two tools suggest that probably neither tool properly meets the teachers' needs but the characteristics of the tools (that can be considered diametrically opposed) haven't been determinant in the decision; contextual and personal factors seem to play a relevant role in the decision to adopt a tool for designing.

6.10.1.3 Issue 3 – What prevented the use of Learning Design methods and tools (barriers to adoption)

As a result of the case study, I identified two levels of analysis.

The uptake of a Learning Design method (or at least a focus on the design for learning).

The method proposed through the first tool was positively received by teachers even though it was not unanimously considered suitable for their school, since the calendar and the single lessons often undergo changes and interruptions that cause plans being disregarded. One teacher expressed his/her doubts about the usefulness to design the learning activities in that context. A clear distinction between the method and the tool emerged during the interviews where two out of three interviewees expressed appreciation for the proposed method while the tool (the PP) was negatively assessed. This distinction was further deepened in the final questionnaire with the whole cohort of teachers. Even though teachers expressed appreciation for the training and stated that it brought changes in their design practice, just one teacher (not the one who expressed appreciation for the method in the interviews) stated to have concretely adopted the method with a more systematic design of his/her teaching and learning activities, doing it on paper. Reading the motivations of the other teachers, it is clear that they consider both the approach and the tool demanding even though a couple of them see potential advantages in its adoption in terms of lesson formalization. This finding is not in line with the conclusions of Persico et al. (2013) who consider tools to be means that facilitate the use of an approach, and that support the users in respecting the internal coherence of the approach itself.

These results might suggest that the long training, that was one of the solutions I wanted to test, probably changed the teachers' mindset towards Learning Design, raising their awareness about its importance, and produced a change in the practice of some of them, but neither tool was considered suitable for their needs, and this prevented their uptake. The change in the teachers' mindset, which is considered by Asensio-Pérez et al. (2017) important for adoption, might,

then, influence the approach towards Learning Design but in this case did not support the uptake of any tool.

The adoption of a digital tool

As far as adoption of the tools, among the barriers identified through the literature review, the following seem to have interested the teachers involved in the case study.

Time/workload constraints seem to have an important role in the decision to make use of the tool. The reference to time/workload is common in the teachers' answers in the two iterations. This limit was initially cited in relation to the first proposed tool (the PP) that was considered cumbersome and complex. The designs prepared by the four teachers in dyads were very simple. The reflective diary filled in by one of the dyads highlights that the process was time consuming and they couldn't manage it. The same position was expressed by the three interviewees (all of them were authors of the designs) and this was the reason which was most frequently selected when teachers were asked to explain the lack of adoption of the tool in the final questionnaire. It is worth saying that also the second tool, that was selected by the teachers themselves, was judged not able to help them save time, indicating that, probably, it was not only a matter of complexity of the tool but an intertwining of factors. In line with the Straub's analysis of the technology adoption (2009) (see section 4.4) it is possible to identify this issue at the intersection of three categories: the characteristics of the innovation (e.g., the capability of the tool to speed up the process or its ease of use), the context (the time the institution acknowledges for designing, as said in the reflective diary by two teachers) and personal (affective) factors, namely the motivation moving the teacher to the use. Time/workload constraints is also the factor which got the higher rate in the Delphi study (see section 5.3.3) showing a convergent vision of teachers and experts. The impact of lack of time on the use of a Learning Design tool was recently evaluated by Albó and Hernández-Leo (2021). Authors asked teachers to rate how much the lack of time hinder the teachers habit to use the tool they proposed; all the participants gave it the highest value on the rating scale.

Lack of institutional support is among the barriers which got the highest rates in the Delphi study (see section 5.3.3). In the literature review under the factor 'Institutional support' I cited (i) the findings of Masterman and Manton (2011) who talked about the interoperability between the tool adopted and administrative and pedagogic systems and (ii) Pozzi et al. (2015a) who mentioned the technological infrastructure. The case study led me to understand this factor more broadly, considering the different ways in which an institution can support the adoption of a methodological or technological innovation. In this case study the institution apparently supported the introduction of Learning Design methods and

tools, acting as the proponent of the course for the teachers. On the other hand, according to teachers, the institution did not grant more paid time to carry them out and did not reduce other commitments. This complaint was expressed 'between the lines' by teachers in the interviews and was expressed in the reflective diary by a dyad, even though it was never selected among the barriers in the questionnaires. Apparently, teachers complained about the lack of time for designing, but they did not recognize it as the result of limited institutional support (which probably is). It also came out that teachers design their courses with an institutional tool for macro design and this is considered mandatory, unlike the design of the single lessons/activities that is expected by the school, but never verified or promoted.

Conceptual complexity of methods and tools was also reported by the teachers in the different phases of the study. This can be true for the first tool proposed, but it couldn't affect the decision to adopt the second tool, which had been proposed by the teachers themselves and was definitely easy to be used and quite intuitive. However, this result could be read in light of the findings of Prieto et al. (2014), who found that an initial experience with a more complex tool, followed by an easier one, hindered the use of both tools after the workshop in which the research was conducted.

Going to intrinsic barriers, teachers were quite at their ease with technologies and used them during their lessons, therefore the factor '**Use of ICT in teaching practice**' couldn't have affected the use of the tools proposed and it was rarely reported during the study. Of course, these teachers are not interested in the automatic implementation of designs in learning management systems and this may have influenced the interest for a digital solution.

Individual motivation towards the use of the method and tool(s) remained low, despite the fact that most teachers recognized the value of Learning Design. As mentioned above, the reason may be the time/workload, which affects motivation and drives their decisions in adoption. Teachers, especially in the interviews, complained about lack of time for designing and reflecting on their teaching; this may clearly influence their priorities. The balance between costs and benefits probably was found to be at the expense of the latter, a situation already highlighted as a possible obstacle by Prieto et al. (2014) and Albó and Hernández-Leo (2021).

Finally, one barrier that did not come out from the literature review but was suggested by experts in the Delphi study, i.e., '**Scarce adherence to teachers' needs/practice**', was indicated by two of the teachers in the final questionnaire among the barriers to the PP adoption. According to the data collected through the interviews the problem appears to be mainly linked to the mismatch between the proposed tool and the characteristics of the context (a vocational training school with some teachings having a laboratory nature, where the schedule suffers from

frequent changes and lessons are often interrupted) and the requests made by the institution.

6.10.2 RQ2 - Solutions to support adoption

6.10.2.1 Issue 1 – How can adoption be supported?

As presented in the results sections, some solutions were implemented according to the barriers identified thanks to the literature review and the results of the first iteration (see Table 6.4 and Table 6.13).

Data collected during the two cycles raised the following considerations.

As far as the **institutional support,** in the case study the support of the institution was formal. The involvement of the director and his delegate (the local responsible) was active in the first part of the training. Afterwards, despite the fact that the delegate was constantly updated about the progress of the training (and participated in a training session at the beginning of the second cycle) no actions were taken to facilitate the teachers' uptake of the method and tools (e.g., teachers were not given extra paid time in order to design their activities or rewarded for well-designed learning activities). Teachers complained about the workload imposed by the school and the scarce time available to design their teaching. This makes evident that to reach a successful adoption of a method/tool at school level the role of the institution is paramount. It should not just set up training opportunities for the teachers, but communicate the importance of that training for the institution and recognize teachers' efforts towards the real uptake of what they have learnt, rewarding commitment and results; even though Albó and Hernández-Leo (2021) recently found that institutional recognition was not considered important by the majority of the participants in their study, they acknowledged that it might motivate others.

Regarding **teacher training,** despite the long-term training and the constant availability of trainers in supporting teachers, the tools were not used; the motivation 'insufficient training' was raised just in the follow up questionnaire [Q3] but not afterwards (in the reflective diary, interviews and end of the training questionnaire [Q4]) indicating that teachers recognized the training opportunity, but that this did not significantly affect the actual adoption of the tools. Data showed that the training was able to raise teachers' awareness as to the importance of designing learning but other aspects, like the lack of time and the heavy workload, seem to have prevented in the majority of the teachers the uptake of the specific approach conveyed by the PP and of both tools (PP and Jamboard).

Adoption by colleagues is one of the aspects that, according to the literature and the teachers themselves, could foster the adoption of a tool. Although the training and the tasks pushed teachers collaborating and sharing by means of the tools, these were not adopted. Of course, I can assume that my effort in this direction was not enough, but one of the teachers in the interviews highlighted scarce opportunities of (structured) collaboration among colleagues due to the lack of dedicated time and places and the workload. Again, the institution and the organization of work seem to have played a role in the method and tool adoption. It must be said that both the PP and Jamboard can support collaboration within the institution but do not support cooperation and exchanges with communities of teachers beyond the institution, an opportunity that might trigger teachers' motivation.

To overcome the **time/workload issue** a 'light use' of the first tool (PP) was proposed, selecting just some of the available functionalities. This solution was not sufficient in order to support the use of the tool that, in fact, was limited to the accomplishment of a task. Even the second tool, Jamboard, was not considered able to speed up the design process. In this specific context the point is probably that designing is not a habit, but something that teachers occasionally make in a very rough way. The training increased teachers' awareness about the importance of designing learning but did not significantly change their habits. For this reason, both types of Learning Design tools (those that imply a systematic approach to design and those that are less structured), probably, would be considered not useful or time-consuming. Again, probably the context, with its requests, is determinant.

Regarding **tool complexity**, the first tool, the PP was considered complex and cumbersome by teachers. For this reason, in the second part of the training a quite easy to use tool was identified by the teachers, and its use was agreed. Jamboard was considered easy to use but, despite this, teachers did not use the tool after the training. The availability of a more intuitive and easier to use tool was not sufficient to increase the use of a digital tool for designing in this specific context, probably because other factors more linked to the context itself did not change.

As to the **alignment between the teachers' needs/practice and the tools**, Albó and Hernández-Leo (2018) proposed as a rule to facilitate adoption of Learning Design tools which seek to connect with teachers' existing practices. In the case study, the effort to find a tool better aligned with the teachers' needs/practice did not lead to its use. Jamboard can be considered the 'digital version' of the support that these teachers declare to use for designing: a piece of paper. Moreover, it includes several features able to speed up the design and support the delivery to students. Despite this, the rating of the tool was low as well as the intention to use it. As already commented, the problem can be linked to the context. These teachers were not motivated to design their teaching since their

institution did not ask them to design (or recognize the effort) and they claimed they did not have time for designing. Therefore, even though they consider it a desirable practice they tend to rarely formalize the design of their teaching activities. It must be said that the problem of the lack of time for designing is reported in literature even for tools developed in close collaboration with teachers and therefore aligned with their practices (Albó & Hernández-Leo, 2021).

6.10.2.2 Issue 2 – Changes in the design practice

Regarding the changes in the design practice, the group of teachers involved in the research used to macro-design their teaching as requested by the school but not to design learning paths or single learning activities, if not occasionally and in an unstructured way.

According to the teachers, the training has brought a change in the teachers' design practice in terms of a greater attention to design and a more structured approach to it, nevertheless just one of them took some elements of the proposed method and the use of the tools remained scarce. Therefore, as already said before, the training somewhat affected the teachers' practice, but this did not lead to the uptake of the proposed method and tools.

6.10.3 Methodological considerations

As for the other two methods, the methodology used to carry out the case study and the contribution of technologies along with their methodological implications were discussed in a published paper (Dagnino et al., 2020). As described in section 6.7, data in the case study were collected through several techniques. Primary data collection tools used in the case study were: 1) Limesurvey, to deliver two questionnaires, 2) Skype, to carry out remote interviews, and 3) the two tools to support Learning Design. The advantages and implications of using an online survey system have been already presented in section 5.4. Regarding Skype, one of the main advantages was its affordance to organize the calls at the interviewees' convenience, while I did not need to travel to reach the teachers' workplace. Moreover, thanks to the use of a videoconferencing system, I was able to show visual prompts (see section 6.7.3.4) and to collect non-verbal indexes, even though the medium might alter perceptions. Additionally, the possibility to record the interviews allowed me to watch the recordings several times and transcribe them, allowing an in-depth analysis. Rare technical problems (mainly due to the low quality of Internet connection) affected the quality of short pieces of the interviews. The tools to support Learning Design have a completely different

aim, but thanks to their capability to support the Learning Design process and store the designs, I was able to collect and analyse designs produced by the teachers, and also the decisions taken during the design process.

For data management I relied on Excel (for questionnaires) and MAXQDA. In the case study this last tool was used to manage the qualitative data coming from the interviews of the teachers. The software sped up the coding process, since two coders were able to tag text and had their codes recorded; moreover, it supports data analysis because it has a number of dedicated functions. Consequently, MAXQDA can be considered a technology in between the two categories of data management and data processing, visualization and analysis. Finally, SPSS Statistics was used to perform descriptive and inferential statistical analyses on data coming from the questionnaires. The use of this digital tool required a pre-existing competence.

6.11 Conclusions

The case study had the objective to study the adoption of Learning Design methods and tools in a cohort of teachers, through a long-term study, and, in particular, to:

- Analyse teachers' needs and barriers to adoption resulting from the systematic literature review (reported in chapter 4) and Delphi study (reported in chapter 5) in the context of a case study.
- Explore possible solutions to overcome the barriers, developed in consequence of the systematic literature review or suggested by experts in the Delphi study.

My approach was intentionally broad, not limited to the users' evaluation of the tools proposed; the study explored aspects pertaining to the context in which the research was carried out and personal factors. This approach allowed me not only to analyse the role of these factors in the adoption of the tools but also how these factors interact one with the other.

This case study was carried out in a specific cohort of teachers working in a vocational training institution; not all these teachers were trained in teaching, therefore they did not have a strong background in Learning Design. They were required to design their teaching at macro-level from the school, while micro-design appeared to be disregarded at the beginning of the research and, despite a formal endorsement of the institution, this situation persisted for the whole duration of the study.

The long-term training increased the teachers' awareness about the importance of designing teaching and produced some changes in their practices but did not lead to the use of the proposed tools. The teachers' behaviour did not

seem particularly linked to the kind of tool, since the two tools were diametrically different: one that was highly structured and provided a strong guidance during the process, and a second one that was a sort of blank canvas. Data collected suggest that the lack of time and heavy workload was the factor that significantly affected the use of the tools, regardless of their specific characteristics. Probably, the point in this cohort is that they were not required to design, and the school did not grant them time or rewards for designing; therefore, despite the changes in their attitude towards design, they were not motivated to do it.

Similarly, other specific contextual factors (e.g., the laboratory nature of some disciplines, the scarce predictability of the lessons, the scarce opportunity to share learning activities and collaborate) influenced teachers' motivation to adopt Learning Design methods and tools.

The importance of some contextual factors (like the time/workload) is in line with the literature and experts' opinions collected through the Delphi study. Motivation and contextual factors came out as highly intertwined. Even though the teachers have increased their awareness about the importance, the relative stability of the boundary conditions have been probably determinant. In the next chapter, 7, I'll draw the final conclusions in relation to these results.

Chapter 7
Conclusions and future works

This chapter presents the overall conclusions of the thesis and discusses the research contributions and how these helped achieve the objectives and address the main research goal (i.e., study how to encourage the adoption of Learning Design methods and tools). In particular, the first contribution, i.e., the list of factors (teachers' needs and barriers) affecting adoption and their relative importance, is the result of a systematic approach to the problem of the lack of adoption. The second contribution, consisting of a list of possible solutions to support adoption, can represent a reference for researchers or other stakeholders who may want to support the adoption of Learning Design in specific contexts. In this chapter, the limitations of the thesis work and the corresponding future works will also be discussed, both in terms of further developments of the present dissertation and the potential impact of the results in the field of Learning Design research. Finally, the dissemination and exploitation of the results of this thesis work are presented. The contents of this dissertation were published in two JCR (Journal Citation Reports) indexed journals, i.e., the academic community has already partially validated the relevance and originality of the contributions.

7.1 Conclusions

The problem of the adoption of Learning Design methods and tools is widely recognized in the research community; despite the efforts of the researchers in developing new methods and tools to support the Learning Design process, the impact on the teachers' community seems to remain scarce (Asensio-Pérez, et al., 2014; Bennett, et al., 2017; Hernández-Leo, et al., 2018). This represents a gap in the field and led me to investigate how the adoption of Learning Design methods and tools can be encouraged. A first step in this regard was to understand the problem. A preliminary exploratory analysis of the literature showed that prior to

this dissertation the reasons behind the lack of adoption of methods and tools had not been investigated systematically; the only literature review available, by Celik and Magoulas (2016b), investigated the teachers' actual perception of computer systems supporting Learning Design and teachers' needs, but did not consider what can hinder the adoption. As far as barriers to adoption, as described in chapter 2, Asensio-Pérez and colleagues (2017), tried to summarise the findings and reflections of different researchers, identifying three areas in which barriers may reside in: [1] the characteristics of Learning Design tools, [2] the teachers' mindset, and [3] the teachers' training; nevertheless, this work represented only a preliminary attempt to approach the issue from a comprehensive point of view. The lack of a more general vision of the factors affecting adoption has probably influenced the approach used to encourage it. This gap motivated me to identify the two objectives of this dissertation:

OBJ1: Understand the factors behind the limited adoption of Learning Design methods and tools by teachers.

OBJ2: Identify actions/solutions to be taken to support the adoption of Learning Design methods and tools.

Considering the complexity of the problem and the multiple sources of information, I identified mixed methods as the most suitable research approach. As highlighted in chapters 1 and 3, the strength of this complex approach lies in the use of multiple methods for collecting and analysing data in order to increase the trustworthiness of the study. The design of the study envisaged three methods: a systematic literature review, a Delphi study and a case study. Each of these methods allowed me to consider different sources of information (literature, experts and teachers) and employ the corresponding (qualitative and quantitative) data collection and analysis techniques.

My first objective, *OBJ1: Understand the factors behind the limited adoption of Learning Design methods and tools by teachers*, led me to set the first expected contribution of the thesis, **C1: A list of factors (needs and barriers) affecting adoption of Learning Design methods and tools.**

I assumed this double perspective (teachers' needs and barriers), since needs (and therefore the capability of methods and tools to address these needs) are as important as barriers in explaining the adoption of Learning Design methods and tools.

In addition, I wanted to reach a deeper level of analysis by examining the relative importance of these factors, i.e., whether one of the categories of factors (needs and barriers) was deemed prominent by experts in the field in respect to the others, as well as which factors had a greater impact according to them.

To achieve this contribution, I started with a **systematic literature review** which gave me an overview of the available research in the field. The systematic review was guided by two research questions: (1) "What are (school and universi-

ty) teachers' needs for Learning Design tools?"; and (2) "What are the main barriers to the adoption of Learning Design tools and the proposed design practices?". The results showed that while there are studies on teachers' needs and design practices, barriers have hardly been the focus of researchers, given that existing research was mostly oriented to the users' experience (ease of use/ usefulness) regarding specific tools. Barriers have been, therefore, indirectly inferred from teachers' answers and comments reported in the studies included in the systematic review, while needs were both directly retrieved and inferred.

The lists of needs and barriers derived from the systematic literature review are reported hereunder. Barriers to adoption were further classified following the categorization proposed by Ertmer (1999), who introduced two orders of barriers to technology integration: extrinsic barriers and intrinsic individual barriers.

Needs:

1. Easiness of use
2. Time saving
3. Support for reuse and adaptation
4. Coherence with the teachers' design thinking
5. Flexibility
6. Form of representation (visual/textual)
7. Support for cooperation
8. Support for reflection.

Barriers:

1. Time/workload factors (extrinsic)
2. Lack of institutional support (extrinsic)
3. Lack of adequate teacher training (extrinsic)
4. Conceptual complexity of methods and tools (extrinsic)
5. Adoption by peers (extrinsic)
6. (Lack of) motivation (intrinsic)
7. (Scarce) use of ICTs in teaching practice (intrinsic).

The eight needs emerged from the review are, as expected, focused on the methods and tools, while the seven barriers identified regard mainly contextual or individual aspects.

The categories and the list of teachers' needs and barriers were then proposed to a panel of experts in Learning Design during a **Delphi study**. In the study experts were required: 1) to rank the importance of the three categories of factors ('Teachers' needs', 'Extrinsic barriers' and 'Intrinsic barriers'), in relation to the adoption of Learning Design methods and tools and 2) to rate the influence of specific teachers' needs and barriers on the adoption.

As far as the three categories of factors, they were considered almost equally important in affecting the adoption of Learning Design methods and tools, but 'Teachers' needs' was indicated as the category deserving further study. As discussed in section 5.4, this suggestion highlighted a gap in the research in the field that was more oriented to tools evaluation. Regarding the single needs and barriers, experts helped me to identify their relative importance, by rating them on a five-point Likert scale. Moreover, they added needs and barriers that were not found in the literature and rated them.

In Table 7.1 the needs and barriers listed in the order resulting from the two rounds of the Delphi study are reported. In the upper part of the table the needs and barriers from the systematic literature review are listed, while the added items are reported in the lower part of the table.

The ratings confirmed the importance of all the needs and barriers emerging from the systematic literature review that were all rated above the midpoint of the scale (3). Also, the needs and barriers proposed by experts got high rates, excluding the 'Lack of creativity' and 'Negative attitudes of students towards Technology Enhanced Learning' which received a mean rate below the midpoint of the scale.

Needs and barriers were also explored in the context of the **case study** (see chapter 6) in which teachers basically confirmed the needs which emerged from the systematic literature review, showing a quite similar view to the one by experts in terms of importance of the different factors. As far as barriers, findings are in line with the results of the systematic literature review and the Delphi study but the context where the case study took place may have played a role in the weight that the different barriers had on adoption, as it has been discussed in sections 6.10 and 6.11.

The final list of factors and the reflections triggered (discussed in depth in the chapters 4, 5 and 6) represent the first contribution of this dissertation and can have several implications for the research field of Learning Design that will be discussed in section 7.3.

As reported in section 3.4, to increase the trustworthiness of the study, I pursued some strategies indicated in the literature by Lincoln and Guba (1985). Triangulation is one of these strategies; as above described, I triangulated the results of the systematic literature review, of the Delphi study and the case study; moreover, within the case study I collected data using multiple data collection and analysis techniques and I triangulated them.

Table 7.1 - Final list of teachers' needs and barriers to adoption after the Delphi study

	Needs	*Barriers*
From SLR	Easiness of use	Time/workload factors (Extr.)
	Time saving	Lack of adequate teacher training (Extr.)
	Flexibility	Lack of institutional support (Extr.)
	Support for reuse and adaptation	Conceptual complexity of methods and tools (Extr.)
	Coherence with the teachers' design thinking	Adoption by peers (Extr.)
	Form of representation (visual/textual)	(Lack of) motivation (Intr.)
	Support for reflection	(Scarce) use of ICTs in teaching practice (Intr.)
	Support for cooperation	
From experts	Examples of designs	Scarce adherence to teachers' needs/practice (Extr.)
	Low cost (money and time) solutions	Lack of confidence with technology (Intr.)
	Support for conceptualization/ creation of learning designs	Scarce adaptability of tools to context/curriculum (Extr.)
	Support for pedagogical creativity	Lack of support for orchestration (Extr.)
	Support for deployment (in technology-based learning environments)	Lack of creativity (Intr.)
	Reward for sharing	Negative attitudes of students towards TEL approaches (Extr.)
	Support for orchestration	
	Interoperability among LD tools	
	Support of learning analytics informing LD	

Legenda: Extr. (Extrinsic); Intr. (Intrinsic)

The approach taken to the issue of adoption, namely the analysis of needs and possible barriers, led to the second objective of this dissertation, *OBJ2: Identify actions/solutions to be taken to support the adoption of Learning Design methods and tools*. Indeed, this thesis work aimed to identify possible solutions addressing

some of the needs and barriers and test these solutions to assess their effectiveness in a real context and eventually feed the second expected contribution of this work, **C2: Possible solutions to support adoption.**

Solutions were initially conceived to address the needs and barriers derived from the systematic literature review in a concrete setting, the case study (see section 6.8.1); afterwards experts were required to propose their solutions during the Delphi study (see section 5.3.4) and some of them were applied in the case study as well (see section 6.9.1).

As described in chapter 6, in the context of the case study teachers were presented with two tools. The first one was a tool designed for supporting the process of Learning Design and providing guidance; during the first iteration the needs and barriers derived from the systematic literature review were addressed. The second tool, instead, was identified by the teachers themselves and was not a tool created on purpose for Learning Design, but it was chosen to replace 'pen and paper', which were the tools teachers declared to use for their everyday design activities. For the second tool the needs and barriers detected in the specific context of the case study, as well as some of those resulting from the Delphi study, were considered.

It is worth noting that, as stated in section 3.4, the approach taken and the methods adopted, especially the case study, do not target for generalizability of the results but rather for their transferability. Thus, specific measures suggested by Lincoln and Guba (1985) were adopted to increase the trustworthiness. In the case study, I triangulated the results of questionnaires, interviews and the analysis of the designs. Moreover, as suggested by Lincoln and Guba (1985), the study was long-term, so it envisaged a prolonged involvement with teachers. This allowed me to understand the context and build a trusting relationship with them. Moreover, I resorted to the thick description of the case study to put the reader in the condition of deciding on the transferability of the results.

Said that, some considerations can be done regarding the second contribution.

As far as the needs, I pursued solutions mainly connected to the tools' features (ease of use, flexibility, etc.). Of course, some solutions proposed by experts could not be applied in the context of the case study, for example it was not possible to use participatory design to develop a new tool, since for pragmatic reasons the Learning Design tools used for training had already been developed. However, in the second iteration of the case study teachers used a second tool that was suggested by them. As pointed out in section 6.10, none of the tools used in the case study adequately met teachers' needs, but their characteristics (which can be considered diametrically opposed) seem to have only partially contributed to hindering their adoption, while contextual and personal factors seem to have been preeminent.

Proposed solutions to barriers proved to address the related problems, but at the same time they were insufficient to achieve the goal of supporting adoption. For example, the long-term teacher training and the constant availability of trainers in supporting teachers were effective in raising teachers' awareness as to the importance of designing learning and on the method proposed, but not impactful on tool adoption. The support of the institution proved to be a crucial point having multiple facets related to other extrinsic barriers (like the workload, that the institution can decide to lower to support the teacher) but also to the intrinsic barrier of motivation. As some experts highlighted in the Delphi study and as confirmed in the specific context of the case study, the importance attributed by an institution to the Learning Design practice does have an impact on teachers' behaviours. This was basically the main problem detected in the case study: the institution's endorsement was only formal but did not result in any change in teachers' workload or in any concrete institutional recognition of the effort by teachers. The issues of time granted and actual endorsement by institutions were already raised in the past by Kirschner (2015) as a challenge associated with the design of Technology Enhanced Learning. Recently, Albó & Hernández-Leo (2021) explored the impact of institutional support on adoption asking teachers if the lack of institutional recognition might hinder the use of the tool they proposed. Most of the teachers in their research did not consider institutional recognition of their work in documenting their designs to be important. For sure, the factor broadly defined 'Institutional support' has different facets that need to be further explored. As said above, the support of the institution to which the teacher belongs is linked with intrinsic motivation. Indeed, motivation may arise from a personal interest for innovation and professional growth, but also from benefits brought to the school/university context (save time, for example). Raising awareness can be effective to motivate certain teachers, but bringing benefits at work level could work even more. In this vein, institutions should be aware that, if they really want to drive a change, providing teachers with training opportunities should be a starting point, that should be then accompanied by some forms of concrete acknowledgement or recognition for the effort put in Learning Design, even in terms of monetary benefits.

To the best of my knowledge, the approach I took in this dissertation is innovative in the field since it foregrounded and addressed the problem of adoption, studying it in an ecological context, with a case study. Looking at the literature, only Celik and Magoulas (2019) recently focused on it, but they involved experts in Learning Design; as far as the development of new tools, only Albó and Hernández-Leo (2018, 2021) talked explicitly of the problem of adoption in their works and set up the development and evaluation process having it in mind.

Looking at the first contribution (the list of the teachers' needs and barriers) in the light of the most recent literature (see section 4.5), it is evident that almost

the same needs can be retrieved in the papers; the only new need emerged from the update of the review is 'Need for sharing (part of) the design with students', indicating a teachers' increasing interest in sharing the design process (or its results) with students. The recent literature showed a greater attention of researchers towards teachers' needs, in line with the experts' opinion expressed in the Delphi study. A few recent papers illustrate researchers' attempts to study more deeply some of these needs to reach a better comprehension of the phenomenon (see for example Pozzi et al., 2020 and Zalavra et al., 2021, as far as flexibility and guidance, or Zalavra et al., 2023 about representation). On the other hand, attention towards barriers remains limited, also because longitudinal studies are scant and mainly focused on the development phase (for example Albó and Hernández-Leo (2018, 2021) studies for the development of edCrumble, or Kurvits et al. (2019) for Le Planner), despite the fact that longitudinal studies involving teachers are considered important in education (Beck, Kosnik, & Rosales, 2017) and also in the specific context of the evaluation of tools for Learning Design (Mastermann, 2015).

The second contribution, i.e., possible solutions to support adoption, resulted in a reflection especially on factors that are 'tool-independent', namely that are related to the context or the individual, and their interplay (institutional support, time/workload, motivation). The more recent literature showed that researchers in the field of Learning Design keep orienting their efforts towards a participatory approach in the development of Learning Design solutions, so as to intercept and meet teachers' needs (see, for example, Albó & Hernández-Leo, 2018 or Kurvits et al., 2019). Even if developing a tool addressing the needs of the teachers may, of course, facilitate its adoption, in this thesis I argue that 'tool-independent' factors shouldn't be disregarded. Specific attention should be paid to the institutions in which teachers work, since they have a role in determining teachers' workload and priorities that actually can influence upstream the choice of designing for learning (and therefore also to adopt a method and/or a tool). This suggestion is in line with experts' opinions (see section 5.3.4). A more comprehensive approach, which includes contextual and personal factors, was suggested also by Straub (2009) in relation to technology adoption in general.

7.2 Limitations

The research and the resulting contributions present some limitations that are discussed in the following.

As far as the first contribution, the main limitation resides in the fact that more attention was paid to the **researchers' perspective on teachers' needs and barriers to adoption rather than to the teachers' perspective**. The list of fac-

tors (needs and barriers) resulted, indeed, from the analysis of the literature and the experts' opinions in the Delphi study. Although some experts were also teachers (and therefore looked at the issue from a double perspective), this research design component may have influenced the list both as far as the factors emerged and the importance given to the factors. On the other hand, I could not have used the Delphi method with teachers since it is oriented to experts in one field, which is not the case of teachers with Learning Design. Moreover, one of the conclusions reached at the end of the systematic literature review was that the field lacked long-term studies in which adoption was actually investigated.

For these reasons, I decided to explore needs and barriers in the authentic context of the case study, grounding on the list derived from the systematic literature review and afterwards the Delphi study and asking teachers to identify new ones. Although the results of the case study may reflect the context in which it was carried out, the data collected are in line with the findings of the systematic literature review and the Delphi study, confirming a certain convergence of the two perspectives.

As for the second contribution, the main limitation lies in the fact that the **solutions were studied in the context of the case study only**. This was dictated by the double need to monitor the adoption process, but also to propose solutions and evaluate their effect in the long term. Of course, the possibility of studying Learning Design adoption in multiple contexts (a multiple case study) would have allowed me to collect more data that would have contributed to an increased credibility of the conclusions. However, more than one long-term study would not have been sustainable in the context of this thesis.

Finally, there are **methodological limitations:** while the results of systematic literature review and the Delphi study can be considered robust and may contribute to more generalizable conclusions, the case study presents some limitations linked to the specific characteristics of the study itself:

- Characteristics of the context: as said in chapter 6, this case study was an instrumental one, namely it was aimed at providing insight into an issue (the adoption of Learning Design methods and tools). Therefore, the context was identified according to the specific needs of the study, i.e., a context in which a training on Learning Design methods and tools was underway. This prerequisite was paramount since I needed to study the process of adoption from the very initial phase. The identified case was a vocational training institute that, as described in section 6.4.1, has peculiarities that may have affected the results and therefore the transferability of the results.
- Changes in the sample of teachers involved: due to the length of the study (about two years) the sample was subject to increase/decrease of the number of participants and teachers' turnover. This resulted in a core

group of teachers that attended the training from the beginning to the end and some others that took part just in some parts that were, anyway, involved in data collection. I tried to overcome this issue by tracking the data collected for each teacher and focusing mainly on the core group to draw conclusions.

- Implementation of multiple solutions in each round of the study: being the study explorative and conducted in an ecological setting it wasn't possible to focus on a specific barrier and try to address only that one; during each iteration multiple solutions were implemented. This made drawing conclusions more difficult and probably less reliable since it was not possible to assess the effect of specific solutions.

As already discussed, to mitigate the effects of the above limitations, I have implemented some of the strategies suggested by Lincoln and Guba (1985).

7.3 Future works

In view of the results of this thesis work and of the above-mentioned limitations, I identified possible future developments of this research:

1. **Deepening the analysis of needs and barriers with an extensive consultation of teachers' perspective**

As said above, in this work the experts' perspective was deeply studied through the systematic literature review and the Delphi study, while the teachers' perspective was explored in a small cohort of teachers who had approached the topic of Learning Design in a critical and reflective manner for the very first time. A future development might be to involve teachers who have longer personal experience in the field of Learning Design in a consultation process with the same goal as the one conducted for this thesis, namely, to assess the needs and barriers included in the list and propose new ones. This will provide further insights into them and allow teachers' perspectives to be compared with those of experts.

2. **Involving educational institutions to explore adoption**

Since the adoption of Learning Design methods and tools can result from an individual decision but also from the impulse of an institution, it would be useful to engage stakeholders who can drive change in teachers' practices (school principals, for example) to identify specific aspects within the factor I have broadly termed 'Institutional Support'. Indeed, the support can take different forms (e.g., recognize the teachers' effort in designing, establish dedicated timeframes for design, offer financial benefits, etc.). The limit of this study was that I identified the overarching factor 'Institutional support' that was intertwined with others, like the workload, and didn't have the opportunity to

better explore it with the representatives of the institution. Unfortunately, in the case study of this dissertation the representatives' involvement was partial and their role poorly recognized. In future works a more active involvement would be advisable, both in terms of barriers analysis and solution testing.

3. Studying solutions in a multiple case study

Solutions to support the adoption which resulted from the present dissertation could be more generalizable if studied in other contexts. In particular, multiple case studies in other educational levels would allow to: 1) explore the impact of the different solutions in different contexts, 2) study the interplay between the different solutions and reach the highest level of detail about specific factors and related solutions. This advancement will contribute to identifying if specific solutions result to be effective in multiple contexts and also to suggesting possible actions to be taken in advance when Learning Design methods and tools are proposed.

The results of this thesis have implications for the research in the field of Learning Design:

1. Needs and barriers as targets in future research on Learning Design adoption

Experts in the Delphi study considered important the study on needs and barriers. This approach may drive future research to successfully address the problem of adoption. In particular, experts recognized that both categories of factors are important in studying adoption and that teachers' needs is an area that requires to be further explored in the future. As discussed in chapters 4 and 5, this finding is not in line with most of the existing related literature, which is more oriented to the analysis of the usability of single tools; this dissertation might raise awareness about this gap and therefore orient future research interests.

2. Valuing teachers' needs in the development of methods/tools

The present dissertation identified specific teachers' needs that should be regarded as requirements in the development of future methods and tools. In other words, these needs correspond to 'basic requirements' that may be complemented with the requirements of the specific context (if any) for which the tool is developed. Similarly, these needs can be taken as a reference also for proposing methods and tools already developed in specific contexts. The importance of considering teachers' needs is also highlighted in one of the emergent needs, that is 'Need for coherence with the teachers' design thinking', which clearly reminds that the proposed methods and tools need to consider the existing teachers' practice (Laurillard et al., 2013). These results support the importance of using participatory and user-centred design approaches for the development of Learning Design tools. The systematic literature review

had highlighted limited use of these approaches in the area of Learning Design, while the recent update of the literature seems to show a growing trend towards actively involving teachers in the design.

7.4 Publications and research projects

In this section I present the publications resulting from the thesis work and the projects linked to it.

7.4.1 Publications

Publications in Indexed Journals (JCR):

(JCR - Impact factor: 6.013) Dagnino, F.M., Dimitriadis, Y., Pozzi, F., Rubia-Avi, B., & Asensio-Pérez, J. (2020). The role of supporting technologies in a mixed methods research design. [El rol de las tecnologías de apoyo en un diseño de investigación de métodos mixtos]. *Comunicar, 65*, 53-63. doi: 10.3916/C65-2020-05

(JCR - Impact factor: 2.588) Dagnino, F.M., Dimitriadis, Y.A., Pozzi, F., Asensio-Pérez, J.I., Rubia-Avi, B. (2018). Exploring teachers' needs and the existing barriers to the adoption of learning design methods and tools: a literature survey. *British Journal of Educational Technology, 49*, 998–1013. doi: /10.1111/bjet.12695

7.4.2 Research projects

The present section reports the research project closely related to the area of this dissertation to which the knowledge acquired during the thesis contributed:

Bakery Cafè. Date: 2017-2019. Funding Entity: Ente Cattolico Formazione Professionale (ECFoP). Principal investigator: Francesca Pozzi. Fund: 13.600€

PLEIADE: Playful Environment for Inclusive Learning Design in Europe. Date: 2020-2023. Funding Entity: Erasmus Program KA2, European Commission (2020-1-IT02-KA201-080089). Principal investigator: Donatella Persico. Fund: 449.937€

References

Agostinho, S. (2011). The use of a visual learning design representation to support the design process of teaching in higher education. *Australasian Journal of Educational Technology, 27*(6), 961-978. doi:10.14742/ajet.923.

Albó, L., & Hernández-Leo, D. (2018). Identifying design principles for learning design tools: The case of edCrumble. In V. Pammer-Schindler, M. Pérez-Sanagustín, H. Drachsler, R. Elferink, & M. Scheffel (Eds.), Lecture Notes in Computer Science: Vol 11082. *Lifelong Technology-Enhanced Learning: 13th European Conference on Technology Enhanced Learning, EC-TEL 2018* (pp. 401–411). Cham: Springer. doi:10.1007/978-3-319-98572-5_31.

Albó, L., & Hernández-Leo, D. (2019). Co-creating a web-based visual representation model for authoring blended learning designs. *Interaction Design and Architecture (IxDA), 42,* 164-182. doi:10.55612/s-5002-042-008.

Albó L., & Hernández-Leo, D. (2021). EdCrumble, a Data-Enriched Visual Authoring Design Tool for Blended Learning. *IEEE Transactions on Learning Technologies, 14*(1), 55-68. doi:10.1109/TLT.2020.3040475.

Amiel, T. & Reeves, T.C. (2008). Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda. *Journal of Educational Technology & Society*, *11*(4), 29-40.

Amorim, R., Lama, M., & Sánchez, E. (2006). Modelling and implementation of the astronomy case study with an IMS LD ontology. *Proceedings of the sixth IEEE International Conference on Advanced Learning Technologies,* Kerkrade, the Netherlands: IEEE Computer Society, 1166-1167, doi: 10.1109/ICALT.2006.1652675.

Arpetti, A., Baranauskas, M. C. C., & Leo, T. (2013). Learning design and teaching practice: Outlining an iterative cycle for professional teachers. *Proceedings of the IEEE 13th International Conference on Advanced Learning Technologies*, ICALT 2013, 280–284. doi: 10.1109/ICALT.2013.87.

Arpetti A., Baranauskas M.C.C., & Leo, T. (2014a). Eliciting requirements for Learning Design tools. In C. Rensing, S. de Freitas, T. Ley, P.J. Muñoz-Merino (Eds.), *Lecture Notes in Computer Science: Vol 8719. Open Learning and Teaching in Educational Communities. EC-TEL 2014*. Springer, Cham. doi: 10.1007/978-3-319-11200-8_1.

Arpetti, A., Baranauskas, M. C. C., & Leo, T. (2014b). Grounding Learning Design on teaching practice: The LEDITA Learning Design Tool for Italian Language teachers. *Proceedings of the 14th IEEE International Conference on Advanced Learning Technologies*, 706–710. doi:10.1109/ICALT.2014.205.

Asensio-Pérez, J. I., Dimitriadis, Y., Pozzi, F., Hernández-Leo, D., Prieto, L.P., Persico, D., & Villagra-Sobrino, S.L. (2017). Towards teaching as design: exploring the interplay between full-lifecycle learning design tooling and teacher professional development. *Computers & Education*, 114, 92-116. doi:10.1016/j.compedu.2017.06.011.

Asensio-Pérez, J. I., Dimitriadis, Y., Prieto, L. P., Hernández-Leo, D., & Mor, Y. (2014). From idea to VLE in half a day: METIS approach and tools for learning co-design. *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality*, 741–745. doi:10.1145/2669711.2669983.

Bakki, A., & Oubahssi, L. (2021). A Moodle-centric Model and Authoring Tool for cMOOC-Type Courses. *Proceedings of the thirteenth International Conference on Computer Supported Education, CSEDU 2021*, 545-556.

Bakki, A., & Oubahssi, L. (2022). Pedagogical Scenario Design and Operationalization: A Moodle-Oriented Authoring Tool for Connectivist Activities. In B. Csapó & J. Uhomoibhi (Eds.), *Computer Supported Education. CSEDU 2021. Communications in Computer and Information Science*, vol 1624 (pp.451-471). Springer, Cham. doi: 10.1007/978-3-031-14756-2_22.

Barab, S. A., Evans, M., & Baek, E. (2003). Activity theory as a lens for characteriting the participatory unit. In D. Jonassen (Ed.). *International Handbook on Communication Technologies*, Vol. 2 (pp. 199-214). Mahwah, NJ: Erlbaum.

Beck, C., Kosnik, C., & Rosales, E. (2017). Longitudinal Study of Teachers. *Oxford Research Encyclopaedia of Education*. Retrieved from https://oxfordre.com/education/view/10.1093/acrefore/9780190264093.001.0001/acrefore-9780190264093-e-117.

Bennett, S., Agostinho, S., & Lockyer, L. (2015). Technology tools to support learning design: Implications derived from an investigation of university teachers' design practices. *Computers & Education, 81*, 211–220. doi:10.1016/j.compedu.2014.10.016.

Bennett, S., Agostinho, S., & Lockyer, L. (2017). The process of designing for learning: understanding university teachers' design work, *Educational Technology Research and Development, 65*(1), 125-145. doi: 10.1007/s11423-016-9469-y.

Bennett, S., Thomas, L., Agostinho, S., Lockyer, L., Jones, J., & Harper, B. (2011). Understanding the design context for Australian university teachers: implications for the future of learning design. *Learning Media and Technology, 36*(2), 151–167. doi:10.1080/17439884.2011.553622.

Boloudakis, M., Retalis, S., & Psaromiligkos, Y. (2018). Training novice teachers to design Moodle-based units of learning using a CADMOS-enabled learning design sprint. *British Journal of Educational Technology, 49*, 1059–1076. doi:10.1111/bjet.12678.

Bottino, R. M., Ott, M., & Tavella, M. (2011). Scaffolding pedagogical planning and the design of learning activities: An online system. *International Journal of Knowledge Society Research, 2*(1), 84–97. doi: 10.4018/jksr.2011010107.

Brasher, A., Conole, G., Cross, S., Weller, M., Clark, P., & White, J. (2008). CompendiumLD – a tool for effective, efficient and creative learning design. *Proceedings of the 2008 European LAMS Conference: Practical Benefits of Learning Design*, 25-27 June 2008, Cadiz, Spain.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. doi:10.1191/1478088706qp063oa .

Cameron, L. (2009): Planner tools-sharing and reusing good practice. *Teaching English with Technology, 1*, 40–49.

Celik, D., & Magoulas, G. D. (2016a). A review, timeline, and categorization of learning design tools'. In D.K.W. Chiu. et al. (Eds.), *Lecture Notes in Computer Science: Vol.10013. Advances in Web-Based Learning – ICWL 2016* (pp. 3-13). Springer, New York. doi:10.1007/978-3-319-47440-3_1.

Celik, D., & Magoulas, G. D. (2016b). Teachers' perspectives on design for learning using computer-based information systems: A systematic literature review. Paper presented at the UK Academy for Information Systems 21st Annual Conference (UKAIS, 2016). University of Oxford.

Celik, D., & Magoulas G. D. (2019). Challenging the alignment of learning design tools with HE lecturers' learning design practice. In M. Scheffel, J. Broisin, V. Pammer-Schindler, A. Ioannou, J. Schneider (Eds.), *Lecture Notes in Computer Science: Vol 11722. Transforming Learning with Meaningful Technologies. EC-TEL 2019* (pp. 142-157). doi: 10.1007/978-3-030-29736-7_11.

Cohen, J. (1960) A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement, 20*, 37-46. doi:10.1177/001316446002000104.

Cole, Z. D., Donohoe, H. M., & Stellefson, M. L. (2013). Internet-based Delphi research: Case based discussion. *Environmental Management, 51*(3), 511-523. doi:10.1007/s00267-012-0005-5 1.

Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design research: Theoretical and methodological issues. *Journal of the Learning Sciences, 13*(1), 15–42 doi:10.1207/s15327809jls1301_2.

Conole, G. (2010). An overview of design representation. In L. Dirckinck-Holmfeld, V. Hodgson, C. Jones, M. de Laat, D. McConnell, & T. Ryberg (Eds.), *Proceedings of the 7th International Conference on Networked Learning* (pp.482-489).

Conole, G. (2013). *Designing for Learning in an Open World*. New York: Springer Verlag. doi: 10.1007/978-1-4419-8517-0.

Conole, G. (2014). Using Compendium as a tool to support the design of learning activities. In A. Okada, S. S. Buchingam, & T. Sherborne (Eds.), *Knowledge Cartography. Advanced Information and Knowledge Processing* (pp. 199–221). London, UK: Springer. doi:10.1007/978-1-84800-149-7_10

Conole, G. (2016). Theoretical Underpinnings of Learning Design. In J. Dalziel (Ed.), *Learning design: conceptualizing a framework for teaching and learning online* (pp. 42-62). Routledge. ISBN 978113891097-3.

Conole, G., & Culver, J. (2010). The design of Cloudworks: Applying social networking practice to foster the exchange of learning and teaching ideas and designs. *Computers & Education, 54*(3), 679–692. doi:10.1016/j.compedu.2009.09.013.

Conole, G., & Dyke M. (2004) What are the affordances of information and communication technologies?. *ALT-J, 12*(2), 113-124. doi: 10.1080/0968776042000216183.

Conole, G., & Fill, K. (2005). A learning design toolkit to create pedagogically effective learning activities, *Journal of Interactive Media in Education,8,* 9. doi: 10.5334/2005-8.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). SAGE.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE.

Creswell, J. W., & Plano Clark, V. (2007). *Designing and conducting mixed methods research*. SAGE.

Custer, R. L., Scarcella, J. A., & Stewart, B. R. (1999). The Modified Delphi Technique – A Rotational Modification, J*ournal of Vocational and Technical Education, 15*(2), 1-10. doi:10.21061/jcte.v15i2.702.

Dagnino, F.M., Dimitriadis, Y.A., Pozzi, F., Asensio Pérez, J.I., & Rubia Avi, B. (2018). Exploring teachers' needs and the existing barriers to the adoption

of Learning Design methods and tools: A literature survey. *British Journal of Educational Technology, 49*(6), 998-1013. doi:10.1111/bjet.12695 1.

Dagnino, F. M., Dimitriadis, Y., Pozzi, F., Rubia-Avi, B., & Asensio-Pérez, J.I. (2020). The role of supporting technologies in a mixed methods research design. [El rol de las tecnologías de apoyo en un diseño de investigación de métodos mixtos]. *Comunicar*, 65, 53-63. doi:10.3916/C65-2020-05.

Dalkey, N., & Helmer, O. (1963). An Experimental Application of the Delphi Method to the use of experts. *Management Science*, 9(3), 458–467. doi:10.1287/mnsc.9.3.458.

Dalziel, J. (2003). Implementing learning design: the Learning Activity Management System (LAMS). In G. Crisp, D. Thiele, I. Scholten, S. Barker, & J. Baron (Eds.), *Interact, integrate, impact: proceedings of the 20th annual conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)*, Adelaide, Australia 7-10 December 2003 (pp. 593-596). Australasian Society for Computers in Learning in Tertiary Education.

Dalziel, J.R. (2006). Modeling a team-based astronomy task using LAMS. *Proceedings of the sixth IEEE International Conference on Advanced Learning Technologies* (pp. 1152-1153) Kerkrade, the Netherlands: IEEE Computer Society.

Dalziel, J., Conole, G., Wills, S., Walker, S., Bennett, S.,... Bower, M. (2016). The Larnaca Declaration on Learning Design - 2013. In J. Dalziel (Ed.), *Learning design: conceptualizing a framework for teaching and learning online* (pp. 1- 41). Routledge. ISBN 978113891097-3.

Delbecq, A.L., Van de Ven, A.H. & Gustafson, D.H. (1975). *Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes*. Glenview, Illinois: Scott, Foresman.

Derntl, M., Neumann, S., Griffiths, D., & Oberhuemer, P. (2010). Investigating teachers' understanding of IMS Learning Design: Yes they can!. In M. Wolpers, P.A. Kirschner, M., Scheffel, S. Lindstaedt, V. Dimitrova (Eds.), *Lecture Notes in Computer Science*: *Vol 6383. Sustaining TEL: From Innovation to Learning and Practice. EC-TEL 2010* (pp. 62-77). Springer, Berlin, Heidelberg. doi:10.1007/978-3-642-16020-2_5.

Derntl, M., Neumann, S., & Oberhuemer, P. (2011). Propelling standards-based sharing and reuse in instructional modeling communities: The Open Graphical Learning Modeler (OpenGLM). In I. Aedo, N.S. Chen, D. G. Sampson, J. M. Spector, & Kinshuk (Eds.), *Proceedings of the 11th IEEE International Conference on Advanced Learning Technologies, ICALT 2011* (pp. 431–435). Los Alamitos, CA: IEEE Computer Society. doi: 10.1109/ICALT.2011.135.

Derntl, M., Neumann, S., Griffiths, D., & P. Oberhuemer (2012). The conceptual structure of IMS Learning Design does not impede its use for authoring. *IEEE Transactions on Learning Technologies, 5*(1), 74-86. doi: 10.1109/TLT.2011.25.

Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5–8. doi:10.3102/0013189X032001005.

Dick, W. (1987). A history of instructional design and its impact on educational psychology. In J. A. Glover & R. R. Ronning (Eds.), *Historical foundations of educational psychology* (pp. 183–202). Plenum Press.

Dillenbourg, P., & Jermann, P. (2010). Technology for Classroom Orchestration. In M. Khine & I. Saleh (Eds), *New Science of Learning.* New York, NY: Springer. doi:10.1007/978-1-4419-5716-0_26.

Dimitriadis, Y., & Goodyear, P. (2013). Forward-oriented design for learning: illustrating the approach. *Research in Learning Technology Supplement*, 21, 1–13. doi: 10.3402/rlt.v21i0.20290.

Divjak, B., Grabar, D., Svetec, B., & Vondra, P. (2022). Balanced learning design planning: Concept and tool. *Journal of Information and Organizational Sciences, 46*(2), 361–375. doi:10.31341/jios.46.2.6.

Donald, C., & Blake, A, (2009). Reviewing learning designs with HEART: A learning design support strategy. *In Same places, different spaces. Proceedings ASCILITE* Auckland 2009. Retrieved from https://www.ascilite.org/conferences/auckland09/procs/donald-interactive-session.pdf.

Emin, V., Pernin, J. P., & Aguirre, J. L. (2010). ScenEdit: An Intention-Oriented Authoring Environnment to Design Learning Scenarios. In M. Wolpers,

P.A. Kirschner, M., Scheffel, S. Lindstaedt, & V. Dimitrova (Eds.), *Lecture Notes in Computer Science*: Vol 6383. *Sustaining TEL: From Innovation to Learning and Practice. EC-TEL 2010* (pp. 626–631). Springer, Berlin, Heidelberg. doi:10.1007/978-3-642-16020-2_65.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology, Research and Development, 47*(4), 47–61. doi: 10.1007/BF02299597.

European Commission (2016). Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA relevance). European Commission.

European Commission (2021). *Ethics and data protection*. Retrieved from https:// https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ethics-and-data-protection_he_en.pdf.

Falconer, I., Finlay, J., & Fincher, S. (2011). Representing practice: practice models, patterns, bundles …. *Learning, Media and Technology, 36*(2), 101-127. doi: 10.1080/17439884.2011.553620.

Friedman, M. (1940). A comparison of alternative tests of significance for the problem of m rankings. *The Annals of Mathematical Statistics*. *11*(1), 86–92. doi:10.1214/aoms/1177731944.

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *B M C Medical Research Methodology, 13*, 117. doi:10.1186/1471-2288-13-117.

Gibson, J.J. (1979). *The Ecological Approach to Visual Perception*. Houghton, Mifflin and Company.

Giesbers, B., van Bruggen, J., Hermans, H., Joosten-ten Brinke, D., Burgers, J., Koper, R., & Latour, I. (2007). Towards a methodology for educational modelling: a case in educational assessment. *Educational Technology & Society*, *10*(1), 237-247.

Goodyear, P. (2015). Teaching as design. *HERDSA Review of Higher Education*, 2, 27–50.

Goodyear, P., & Dimitriadis, Y. (2013). In medias res: Reframing design for learning. *Research in Learning Technology*, 21. doi:10.3402/rlt.v21i0.19909.

Greene J.C., Caracelli V.J., & Graham W.F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, 11(3):255-274. doi:10.3102/01623737011003255.

Griffiths, D., Beauvoir, P., Liber, O., & Barrett-Baxendale, M. (2009). From reload to ReCourse: learning from IMS learning design implementations. *Distance Education, 30*(2), 201–222. doi:10.1080/01587910903023199.

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and Issues in Instructional Design and Technology* (pp. 16–25). Upper Saddle River, NJ: Pearson.

Hai-Jew, S. (Ed.). (2015). *Enhancing Qualitative and Mixed Methods Research with Technology*. IGI Global. doi:10.4018/978-1-4666-6493-7

Hakkarainen, K., & Paavola, S. (2009). Toward a trialogical approach to learning. In B. Schwarz, T. Dreyfus, & R. Hershkowitz (Eds.), *Transformation of knowledge through classroom interaction* (pp. 65-80). Routledge.

Håklev, S., Faucon, L., Hadzilacos, T., & Dillenbourg, P. (2017). FROG: Rapid prototyping of collaborative learning scenarios. Paper presented at the *12th European Conference on Technology Enhanced Learning*, EC-TEL2017, Tallinn.

Hermans, H., Janssen, J., & Koper, R. (2016). Flexible authoring and delivery of online courses using IMS Learning Design. *Interactive Learning Environments*, *24*(6), 1265–1279. doi: 10.1080/10494820.2014.994220.

Hernández-Leo, D., Asensio-Pérez, J. I., Derntl, M., Pozzi, F., Chacón-Pérez, J., Prieto, L. P., & Persico, D. (2018). An Integrated Environment for Learning Design. *Frontiers in ICT*, 5, 9. doi: 10.3389/fict.2018.00009.

Hernández-Leo, D., Chacón J., Prieto L.P., Asensio-Pérez J.I., & Derntl, M. (2013) Towards an Integrated Learning Design Environment. In D. Her-

nández-Leo, T. Ley, R. Klamma, A. Harrer (Eds.), *Lecture Notes in Computer Science, Vol 8095. Scaling up Learning for Sustained Impact. EC-TEL 2013* (pp. 448–453). Springer. doi: 10.1007/978-3-642-40814-4_37.

Hernández-Leo, D., Moreno P., Carrió M., Chacón J., & Blat J. (2015) Ldshake and the "Biologia en context" teacher community across high schools. In M. Maina, B. Craft, Y. Mor (Eds.), *The Art & Science of Learning Design. Technology Enhanced Learning.* Rotterdam: Sense.

Hernández-Leo, D., Romeo, L., Carralero, M. A., Chacón, J., Carrió, M., Moreno, P., & Blat, J. (2011). LdShake: Learning design solutions sharing and co-edition. *Computers & Education, 57,* 2249–2260. doi:10.1016/j.compedu.2011.06.016.

Hernández-Leo, D., Villasclaras-Fernández, E. D., Asensio-Pérez, J. I., Jorrín-Abellán, I. M., Dimitriadis, Y., Ruiz-Réquies, I., & Rubia-Avi, B. (2006a). Collage, a collaborative learning design editor based on patterns. *Educational Technology & Society, 9,* 58–71.

Hernández-Leo, D., Villasclaras-Fernández, E. D., Asensio-Pérez, J. I., Dimitriadis, Y. A., Bote-Lorenzo, M.L., & Marcos-García, J.A. (2006b). Tuning IMS LD for implementing a collaborative lifelong learning scenario. *Proceedings of the 6th IEEE International Conference on Advanced Learning Technologies*. Kerkrade, the Netherlands: IEEE Computer Society. 1160-1161, doi: 10.1109/ICALT.2006.1652672.

Hew, K. F., & Brush T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research and Development, 55*(3), 223-252. doi: 10.1007/s11423-006-9022-5.

Hsu, C. C., & Sandford, B. A. (2007). The Delphi technique: Making sense of consensus. *Practical Assessment, Research & Evaluation, 12*(10), 1–8. doi:10.7275/pdz9-th90.

Hung, H.L., Altschuld, J. W., & Lee, Y.F. (2008). Methodological and conceptual issues confronting a cross-country Delphi Study of educational program evaluation. *Evaluation and Program Planning, 31*(2), 191–198. doi:10.1016/j.evalprogplan.2008.02.005.

IMS-GLC (2003). Learning Design specification. Retrieved from www.imsglobal.org/learningdesign

Indire (2016). *Avanguardie educative. Linee guida per l'implementazione dell'idea "Aule laboratorio disciplinari*" (prima edizione). Indire. Retrieved from https://innovazione.indire.it/avanguardieeducative/linee-guida-per-limplementazione-dellidea-quot-aule-laboratorio-disciplinari-quot-prima-edizione.

Iqbal, S., & Pipon-Young, L. (2009). The Delphi method: A step-by-step guide. *The Psychologist*, July, 598 – 601. Retrieved from https://www.bps.org.uk/psychologist/delphi-method.

Johnson, J.C., & Weller, S.C. (2001). Elicitation Techniques for Interviewing. In J.F. Gubrium and J.A. Holstein (Eds.), *Handbook of Interview Research: Context & Method* (pp. 491–514). London: SAGE.

Jullien, J., Martel, C., Vignollet, L., & Wentland, M. (2009). OpenScenario: A flexible integrated environment to develop educational activities based on pedagogical scenarios. In I. Aedo (Ed.), *Proceedings of the ninth IEEE International Conference on Advanced Learning Technologies, ICALT* 2009 (pp. 509–513). Riga: IEEE Computer Society Press.

Kalantzis, M., & Cope, B. (2010). The Teacher as Designer: Pedagogy in the New Media Age. E-Learning and digital media, 7(3), 200–222. doi: 10.2304/elea.2010.7.3.200.

Kali, Y. (2008). The design principles database as means for promoting design-based research. In A. E. Kelly, R. A. Lesh, & J. Y. Baek (Eds), *Handbook of design research methods in education* (pp. 423–438). New York: Routledge.

Kali, Y., McKenney, S., & Sagy, O. (2015). Teachers as designers of technology enhanced learning. *Instructional science*, *43*(2), 173-179. doi:10.1007/s11251-014-9343-4.

Kaplan Akilli, G. (n.d.) Design Based Research vs. Mixed Methods:The Differences and Commonalities. Retrieved from https://www.academia.edu/26184599/DRAFT_Design_Based_Research_vs_Mixed_Methods_The_Differences_and_Commonalities.

Katsamani, M., & Retalis, S. (2011). Making Learning Designs in Layers: The CADMOS Approach. In M.B. Nunes & P. Isaia (Eds.), *Proceedings of the IADIS Multi Conference on Computer Science and Information Systems 2011*, Rome Italy, 305-312.

Katsamani, M., & Retalis, S. (2013). Orchestrating learning activities using the CADMOS learning design tool. *Research in Learning Technology, 21*. doi:10.3402/rlt.v21i0.18051.

Kerrigan, M., Headington, R., & Walker S. (2011). Visualising the holistic assessment experience – The use of Google tools to support effective design [Conference presentation abstract]. In L. Habib, A. Jefferies, M. Johnson, & E. Hartnell-Young (Eds.), Eighteenth Educational Conference ALT-C 2011, University of Leeds, UK, (0214 SP). Retrieved from https://repository.alt.ac.uk/2160/1/alt-c_2011_abstracts_v2.6.pdf.

Kirschner, P.A. (2015) Do we need teachers as designers of technology enhanced learning? *Instructional Science*, 43, 309–322. doi: 10.1007/s11251-015-9346-9.

Kitchenham, B., & Charters, S. (2007). Guidelines for performing Systematic Literature reviews in Software Engineering Version 2.3. EBSE Technical Report.

Koper, R. (2001). Modeling units of study from a pedagogical perspective: the pedagogical meta-model behind EML. Heerlen: Open Universiteit Nederland.

Koper, R. (2002). Educational Modeling Language: Adding Instructional Design to Existing Specifications. Technical report, Educational Expertise Technology Centre, Open University of the Netherlands.

Kurvits, M., Laanpere, M., Väljataga, T., & Robtsenkov, R. (2019). Visualising and Re-using Innovative Pedagogical Scenarios. In M. Herzog, Z. Kubincová, P. Han, M. Temperini (Eds.), Lecture Notes in Computer Science: Vol 11841. *Advances in Web-Based Learning – ICWL 2019. ICWL 2019* (pp.177-189). Springer, Cham. doi:10.1007/978-3-030-35758-0_17.

Lame, G. (2019). Systematic Literature Reviews: An Introduction. *Proceedings of the Design Society: International Conference on Engineering Design*, *1*(1), 1633-1642. doi:10.1017/dsi.2019.169.

Landeta, J., (2006). Current validity of the Delphi method in social sciences. *Technological Forecasting and Social Change*, *73*(5), 467-482. doi:10.1016/j.techfore.2005.09.002.

Laurillard, D. (2012). *Teaching as a design science. Building pedagogical patterns for learning and technology*. Routledge. doi:10.4324/9780203125083.

Laurillard, D., Charlton, P., Craft, B., Dimakopoulos, D., Ljubojevic, D., Magoulas, G., … Whittlestone, K. (2013). A constructionist learning environment for teachers to model learning designs. *Journal of Computer Assisted Learning*, *29*(1), 15–30. doi:10.1111/j.1365-2729.2011.00458.x.

Laurillard, D., Kennedy, E., Charlton, P., Wild, J., & Dimakopoulos, D. (2018). Using technology to develop teachers as designers of TEL: Evaluating the learning designer. *British Journal of Educational Technology*, *49*(6), 1044–1058. doi:10.1111/bjet.12697.

Laurillard, D. & McAndrew, P. (2002). Virtual teaching tools: Bringing academics closer to the design of e-learning. *Proceedings of the third International Conference on Networked Learning*, School of Education, University of Sheffield and Lancaster University, UK. 1-16.

Lave, J., & Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511815355.

Levene, H. (1960). Robust tests for equality of variances. In I. Olkin (Ed), *Contributions to Probability and Statistics* (pp. 278-292). Palo Alto: Stanford University Press.

Levy, P. (2015) Technology-Supported Design for Inquiry-Based Learning. In M. Li & Y Zhao (Eds.) *Exploring Learning & Teaching in Higher Education. New Frontiers of Educational Research* (289-304). Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-55352-3_13.

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., … Moher, D. (2009). The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration", *PLOS Medicine*, *6*(7), p. e1000100, doi:10.1371/journal.pmed.1000100.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. Newbury Park, CA: SAGE.

Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing Pedagogical Action: Aligning Learning Analytics with Learning Design. *American Behavioral Scientist, 57*(10), 1439-1459. doi:10.1177/0002764213479367.

Maina, M., Craft, B., & Mor, Y. (Eds.) (2015). *The Art & Science of Learning Design*. *Technology Enhanced Learning*. Rotterdam: Sense. doi:10.1007/978-94-6300-103-8.

Martel, C., Vignollet, L., & Ferraris, C. (2006). Modeling the case study with LDL and implementing it with LDI. *Proceedings of the sixth IEEE International Conference on Advanced Learning Technologies* (pp. 1158-1159), Kerkrade, the Netherlands: IEEE Computer Society.

Masterman, E. (2015). Towards a Principled Approach to Evaluating Learning Design Tools. In Maina, M., Craft, B., Mor, Y. (Eds.) *The Art & Science of Learning Design. Technology Enhanced Learning*. Rotterdam: Sense. doi: 10.1007/978-94-6300-103-8_8.

Masterman, E., & Manton, M. (2011). Teachers' perspectives on digital tools for pedagogic planning and design. *Technology, Pedagogy and Education, 20*(2), 227–246. doi:10.1080/1475939X.2011.588414.

Masterman, E., Walker, S., & Bower, M. (2013). Computational support for teachers'design thinking: its feasibility and acceptability to practitioners and institutions. *Educational Media International, 50*(1), 12–23. doi:10.1080/09523987.2013.777185.

Mayring, P. (2000). Qualitative content analysis, Forum: Qualitative Social Research, 1(2), [online] http://www.qualitative-research.net/index.php/fqs/article/ view/1089/2385 (Accessed 07 October 2023).

McHugh, M. L. (2012). Interrater Reliability: The Kappa Statistic. *Biochemia Medica*, 22, 276-282. doi:10.11613/BM.2012.031.

Mertens, D. M. (2010). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods* (3rd ed.). Thousand Oaks, CA: SAGE.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis. An Expanded Sourcebook.* Thousand Oaks, CA: SAGE.

Molenda, M., Pershing, J., & Reigeluth, C. (1996). Designing Instructional Systems. In R. Craig (Ed.), *The ASTD Training and Development Handbook –A guide to Human Resource Development*, 4th Ed. McGraw-Hill.

Mor, Y. (2011). Design narratives: an intuitive scientific form for capturing design knowledge in education. In Y. Eshet-Alkalai, A. Caspi, S. Eden, N. Geri, & Y. Yair (Eds.), *Learning in the technological era: Proceedings of the sixth Chais conference on instructional technologies research 2011* (pp. 57–63). Raanana: The OpenUniversity of Israel.

Mor, Y., Craft, B., & Hernández-Leo, D. (2013). Editorial: The art and science of learning design. *Research in Learning Technology*, *21*. doi:10.3402/rlt.v21i0.22513.

Mor, Y., Craft, B., & Maina, M. (2015). Introduction – Learning design. Definitions, current issues and grand challenges. In M. Maina, B. Craft, & Y. Mor (Eds.), *The Art & Science of Learning Design. Technology Enhanced Learning.* (pp. ix–xxvi). Rotterdam: Sense.

Mor, Y., & Mogilevsky, O. (2013). The learning design studio: collaborative design inquiry as teachers' professional development. *Research in Learning Technology*, *21*. doi:10.3402/rlt.v21i0.22054.

Morgan, D. L. (2007). Paradigms Lost and Pragmatism Regained: Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research*, 1(1), 48–76. doi:10.1177/2345678906292462.

Mylonakis, M., Arapi, P., Moumoutzis, N., Christodoulakis, S., & Ampartzaki, M. (2013). Octopus: A collaborative environment supporting the development of effective instructional design. *Proceedings of the Second International Conference on E-Learning and E-Technologies in Education* (ICEEE), 260–265. doi:10.1109/ICeLeTE.2013.6644385.

Nath, J. L. (2005). The roles of case studies in the educational field. *International Journal of Case Method Research & Application*, *27*(3), 396-400.

Neumann, S., Klebl, M., Griffiths, D., Hernández-Leo, D., de la Fuente Valentín, L., Hummel, H...Oberhuemer, P. (2010). Report of the Results of an IMS Learning Design Expert Workshop. International Journal of Emerging Technologies in Learning, 5(1), 58-72. doi:10.3991/ijet.v5i1.1045.

Nodenot, T., & Laforcade, P. (2006). Learning from a planets game: elements of a didactical transposition described with the CPM language. Proceedings of the 6th IEEE International Conference on Advanced Learning Technologies (pp. 1164-1165). Kerkrade, the Netherlands: IEEE Computer Society.

Norton, L., Richardson, T. E., Hartley, J., Newstead, S., & Mayes, J. (2005). Teachers' beliefs and intentions concerning teaching in higher education. *Higher Education, 50,* 537–571. doi:10.1007/s10734-004-6363-z.

Olimpo, G. (2010). Società della conoscenza, educazione, tecnologia. *TD-Tecnologie Didattiche 50,* 4-16.

Olimpo, G., Bottino, R. M., Earp, J., Ott, M., Pozzi, F., & Tavella, M. (2010). Pedagogical plans as communication-oriented objects. *Computers & Education, 55*(2), 476–488. doi:10.1016/j.compedu.2010.02.011.

Papanikolaou, K. A., Gouli, E., Makrh, K., Sofos, I., & Tzelepi, M. (2016). A peer evaluation tool of Learning Designs. In K. Verbert, M. Sharples, & T. Klobučar (Eds.), *Lecture Notes in Computer Science: Vol 9891. Adaptive and Adaptable Learning. EC-TEL 2016.* (pp. 193–206). Springer, Cham doi:10.1007/978-3-319-45153-4_15.

Paquette, G., & Léonard, M. (2006). The educational modelling of a collaborative game using MOT+LD. *Proceedings of the sixth IEEE International Conference on Advanced Learning Technologies* (pp. 1156-1157) Kerkrade, the Netherlands: IEEE Computer Society.

Paquette, G., Léonard, M., & Lundgren-Cayrol, K. (2008). The MOT+Visual Language for Knowledge-Based Instructional Design. In L. Botturi & T. Stubbs (Eds.), Handbook of Visual Languages for Instructional Design: Theories and Practices (pp. 132-153). IGI Global. doi:10.4018/978-1-59904-729-4.ch008.

Pérez-Sanagustín, M., Santos, P., Hernández-Leo, D., & Blat, J. (2012). 4SPPIces: a case study of factors in a scripted collaborative-learning

blended course across spatial locations. *International Journal of Computer-Supported Collaborative Learning,* 7(3), 443-465. doi:10.1007/s11412-011-9139-3.

Persico, D. (1997). Methodological constants in courseware design. *British Journal of Educational Technology*, *28*(2), 111–124. doi:10.1111/1467-8535.00015.

Persico, D., & Pozzi, F. (2015). Informing learning design with learning analytics to improve teacher inquiry. *British Journal of Educational Technology*, *4*6, 230–248. doi:10.1111/bjet.12207.

Persico, D., Pozzi, F., Anastopoulou, S., Conole, G., Craft, B., Dimitriadis, Y.,... Walmsley, H. (2013). Learning design Rashomon I - supporting the design of one lesson through different approaches. *Research in Learning Technology, 21*. doi:10.3402/rlt.v21i0.20224.

Petticrew, M. (2001). Systematic reviews from astronomy to zoology: myths and misconceptions. *BMJ*, *322*(7278), 98–101. doi:10.1136/bmj.322.7278.98.

Pishtari, G., Rodríguez-Triana, M. J., Sarmiento-Márquez, E. M., Pérez-Sanagustín, M., Ruiz-Calleja, A.,... Väljataga, T. (2020). Learning design and learning analytics in mobile and ubiquitous learning: A systematic review. *British Journal of Educational Technology, 51*(4), 1078–1100. doi:10.1111/bjet.12944.

Plesch, C., Kaendler, C., Rummel, N., Wiedmann, M., & Spada, H. (2013). Identifying Areas of Tension in the field of technology-enhanced learning: Results of an international Delphi study, *Computers & Education, 65*, 92-105. doi:10.1016/j.compedu.2013.01.018.

Plomp, T. (2007). Educational design research: An introduction. In T. Plomp & N. Nieveen (Eds.), *An introduction to educational design research*. Enschede: SLO.

Porta, M., Mas-Machuca, M., Martinez-Costa, C., & Maillet, K. (2012). A Delphi study on Technology Enhanced Learning (TEL) applied on Computer Science (CS) skills. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 8*(1), 46-70.

Pozzi, F. (2002). Towards a "modular school". *TD - Tecnologie Didattiche*, *10*(2), 18-24. doi:10.17471/2499-4324/511.

Pozzi, F., Asensio-Pérez, J.I., Ceregini, A., Dagnino, F.M., Dimitriadis Y., & Earp J. (2020) Supporting and representing Learning Design with digital tools: in between guidance and flexibility, *Technology, Pedagogy and Education*, *29*(1), 109-128. doi:10.1080/1475939X.2020.1714708.

Pozzi, F., Asensio-Pérez, J. I., & Persico, D. (2016). The case for multiple representations in the learning design lifecycle. In B. G. Kinshuk & M. Maina (Eds.), *Lecture notes in educational technology. The architecture of ubiquitous learning: Learning designs for emerging pedagogies* (pp. 171–196). Berlin: Springer. doi:10.1007/978-3-662-47724-3_10.

Pozzi, F., Ceregini, A., Dagnino, F., Ott, M., & Tavella, M. (2015). Supporting the 'whole learning design life-cycle' through the pedagogical planner. In E. K. Sorensen, A. Szucs, & M. S. Khalid (Eds.), D4Learning conference proceedings (pp. 90-97), Aalborg, Denmark: Aalborg University Press.

Pozzi, F., Ceregini, A., Persico, D. (2016). Designing networked learning with 4Ts. In S. Cranmer, N.B. Dohn, M. de Laat, T. Ryberg, & J.A. Sime (Eds.). *Proceedings of the 10th International Conference on Networked Learning 2016* (pp.210-217). Lancaster, UK, 9-11/5/2016. Retrieved from https://www.lancaster.ac.uk/fss/organisations/netlc/abstracts/pdf/P15.pdf.

Pozzi, F., Ceregini, A., Persico, D., Sarti, L., Brasher, A., Chacón-Pérez, J.,…Serrano, M. A. (2015a). *D5.3: Report on second formative evaluation round*. METIS Project Deliverable.

Pozzi, F., Ceregini, A., Persico, D., Sarti, L., Brasher, A., Hernández-Leo D., & Asensio-Pérez, J.I. (2015b). *D5.4: final evaluation report*. METIS Project Deliverable.

Pozzi, F., Manganello, F., Passarelli, M., Persico, D., Brasher, A., Holmes, W., Whitelock, D., & Sangrà, A. (2019). Ranking Meets Distance Education: Defining Relevant Criteria and Indicators for Online Universities. *International Review of Research in Open and Distributed Learning*, *20*(5), 42-63. doi:10.19173/irrodl.v20i5.4391.

Pozzi, F., & Persico, D. (2013). Sustaining learning design and pedagogical planning in CSCL. *Research in Learning Technology, 21*. doi:10.3402/rlt.v21i0.17585.

Prieto, L., Asensio-Pérez, J., Dimitriadis, Y., Gómez-Sánchez, E., & Muñoz-Cristóbal, J. A. (2011). GLUE!-PS: A multi-language architecture and data model to deploy TEL designs to multiple learning environments. In K. Carlos, G. Denis, G. Raquel Crespo, W. Fridolin, & W. Martin (Eds.), *Lecture notes in computer science: Vol 6964. Towards ubiquitous learning. EC-TEL 2011* (pp. 285–298). Berlin: Springer. doi:10.1007/978-3-642-23985-4_23.

Prieto, L. P., Asensio-Pérez, J. I., Munoz-Cristobal, J. A., Dimitriadis, Y. A., Jorrin-Abellan, I. M., & Gomez-Sanchez, E. (2013). Enabling teachers to deploy CSCL designs across distributed learning environments. *IEEE Transactions on Learning Technologies*, *6*(4), 324–336. doi: 10.1109/TLT.2013.22.

Prieto, L. P., Dimitriadis, Y., Craft, B., Derntl, M., Émin, V., Katsamani, M., Laurillard, D., Masterman, E., Retalis, S., & Villasclaras, E. (2013). Learning design Rashomon II: exploring one lesson through multiple tools. *Research in Learning Technology, 21*. doi:10.3402/rlt.v21i0.20057.

Prieto, L. P., Tchounikine, P., Asensio-Pérez, J. I., Sobreira, P., & Dimitriadis, Y. (2014). Exploring teachers' perceptions on different CSCL script editing tools. *Computers & Education*, *78*, 383–396. doi: 10.1016/j.compedu.2014.07.002.

Reiser, R.A., & Dempsey, J.V. (2007). *Trends and Issues in Instructional Design (2nd ed.)*. Upper Saddle River, NJ: Pearson Education.

Ritchie, J., & Spencer, L. (1994) Qualitative Data Analysis for Applied Policy Research. In A. Bryman, & R. Burgess (Eds.), *Analyzing Qualitative Data* (pp. 173-194). London: Routledge. doi:10.4324/9780203413081_chapter_9.

Rodriguez-Triana, M. J., Prieto, L. P., Vozniuk, A., Shirvani Boroujeni, M., Schwendimann, B. A., Holzer, A., & Gillet, D. (2017). Monitoring, awareness and reflection in blended technology enhanced learning: a systematic review. *International Journal of Technology Enhanced Learning*, *9* (2-3), 126-150. doi:10.1504/IJTEL.2017.084489.

Ronen, M., Kohen-Vacs, D., & Raz-Fogel, N. (2006). Adopt & Adapt: Structuring, Sharing and Reusing Asynchronous Collaborative Pedagogy. Proceedings of the International Conference of the Learning Sciences, June 27-July 1, Indiana University, Bloomington IN. 599-606.

Rother, E.T. (2007). Systematic literature review X narrative review. *Acta Paulista de Enfermagem*, *20*(2), v-vi.

Roztocki, N. (2001). Using internet-based surveys for academic research: Opportunities and problems. Proceedings of the 2001 American Society of Engineering Management (ASEM) National Conference. Huntsville, AL, October 11-13, 2001. (pp. 290-295).

Rowe, G., & Wright, G. (2001). Expert opinions in forecasting: The role of the Delphi process. In J.S. Armstrong, (Ed.), *Principles of Forecasting: A Handbook for Researchers and Practitioners* (pp. 125–144). Boston, MA: Kluwer Academic Publishers.

Schmitz, M., Scheffel, M., van Limbeek, E., Bemelmans, R., & Drachsler, H. (2018). "Make It Personal!": Gathering Input from Stakeholders for a Learning Analytics-Supported Learning Design Tool. In V. Pammer-Schindler, M. Pérez-Sanagustín, H. Drachsler, R. Elferink, & M. Scheffel (Eds.), *Lecture Notes in Computer Science: Vol 11082 Lifelong Technology-Enhanced Learning: 13th European Conference on Technology Enhanced Learning, EC-TEL 2018* (pp. 297-310). Springer, Cham. doi:10.1007/978-3-319-98572-5_23.

Scholz, R. W., & Tietje, O. (2002). *Embedded case study methods*. SAGE. doi:10.4135/9781412984027.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher, 27*, 4–13.

Singh, V. K., Singh, P., Karmakar, M., Leta, J., & Mayr, P. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics, 126*, 5113–5142. doi:10.1007/s11192-021-03948-5.

Skinner, R., Nelson, R. R., Chin, W.W., & Land, L. (2015). The Delphi Method Research Strategy in Studies of Information Systems. *Communications of the Association for Information Systems, 37*. doi:10.17705/1CAIS.03702.

Sobreira, P., & Tchounikine, P. (2012). A model for flexibly editing CSCL scripts. *International Journal of Computer-Supported Collaborative Learning*, *7*, 1–26. doi:10.1007/s11412-012-9157-9.

Stake, R. E. (1995). *The Art of Case Study Research*. SAGE.

Stake, R. E. (2005). Qualitative Case Studies. In N. Denzin & I. Lincoln (Eds.), *The SAGE handbook of qualitative research* (pp.443-466). SAGE.

Stark, J. S. (2000). Planning introductory college courses: Content, Context and form. *Instructional Science*, *28*, 413-438. doi:10.1023/A:1026516231429.

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research*, *79*, 625-649. doi:10.3102/0034654308325896.

Tashakkori, A., & Teddlie, C. (2010). *SAGE handbook of mixed methods in social & behavioural research*. SAGE. doi:10.4135/9781506335193.

Tattersall, C. (2006). Comparing educational modelling languages on a case study: an approach using IMS Learning Design. *Proceedings of the sixth IEEE International Conference on Advanced Learning Technologies* (pp. 1154-1155) Kerkrade, the Netherlands: IEEE Computer Society.

Trowsdale, D., & McKay, A. (2023). EdVee: A Visual Diagnostic and Course Design Tool for Constructive Alignment. *Teaching and Learning Inquiry 11*. doi:10.20343/teachlearninqu.11.3.

Twining, P., Heller, R. S., Nussbaum, M., & Tsai, C.C. (2017). Some guidance on conducting and reporting qualitative studies, *Computers & Education, 106*, A1-A9. doi:10.1016/j.compedu.2016.12.002.

Verbert, K., Ochoa, X., Derntl, M., Wolpers, M., Pardo, A., & Duval, E. (2012). Semi-automatic assembly of learning resources. *Computers & Education*, *59*(4), 1257–1272. doi: 10.1016/j.compedu.2012.06.005.

Vignollet, L., David, J. P., Ferraris, C., Martel C., & Lejeune, A. (2006). Comparing Educational Modeling Languages on a Case Study. *Proceedings of the sixth IEEE International Conference on Advanced Learning Technologies (ICALT'06)* (pp. 1149-1151). Kerkrade, Netherlands. doi: 10.1109/ICALT.2006.1652667.

Vignollet, L., Ferraris, C., Martel, C., & Burgos, D. (2008). A Transversal Analysis of Different Learning Design Approaches. *Journal of Interactive Media in Education, 2*, Art. 24. doi:10.5334/2008-26.

Vignollet, L., Martel, C., & Burgos, D. (Eds.) (2008). Special issue Comparing Educational Modelling Languages on the "Planet Game" Case Study. *Journal of Interactive Media in Education, 2*.

Villasclaras-Fernández, E., Hernández-Leo, D., Asensio-Pérez, J. I., & Dimitriadis, Y. (2013). Web collage: An implementation of support for assessment design in CSCL macro-scripts. *Computers & Education, 67*, 79–97. doi:10.1016/j.compedu.2013.03.002.

von der Gracht, H.A. (2012). Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technological Forecasting and Social Change*, *79*(8), 1525–1536. doi: 10.1016/j.techfore.2012.04.013.

Voogt, J., Westbroek, H., Handelzalts, A., Walraven, A., McKenney, S., Pieters, J., & de Vries, B. (2011). Teacher learning in collaborative curriculum design. *Teaching and Teacher Education*, *27*(8), 1235–1244. doi: 10.1016/j.tate.2011.07.003.

Vygotsky, L.S. (1962). *Thought and Language*. Cambridge, MA: MIT Press.

Vygotsky, L.S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Walmsley, H. (2015). The E-Design Template. In M. Maina, B. Craft, & Y. Mor (eds.) *The Art & Science of Learning Design. Technology Enhanced Learning*. Rotterdam: Sense. doi:10.1007/978-94-6300-103-8_13.

Wang, F., & Hannafin, M. J. (2005). Design-Based research and technology-enhanced learning environments. *Educational Technology Research and Development*, 53(4), 5-23. doi:10.1007/BF02504682.

Wasson, B., & Kirschner, P.A. (2020). Learning Design: European Approaches. *TechTrends 64*, 815–827. doi:10.1007/s11528-020-00498-0.

Yazan, B. (2015). Three Approaches to Case Study Methods in Education: Yin, Merriam, and Stake. *Qualitative Report, 20.* doi:10.46743/2160-3715/2015.2102.

Yin, R. (1994). Case Study Research: Design and Method. *Applied Social Research Methods Series* (Vol.5). London: SAGE.

Zalavra, E., & Papanikolaou, K. (2019). Exploring the Potential of the Learning Designer as a Teacher Support Tool. *The Electronic Journal of e-Learning, 17*(2), pp. 107-117. doi: 10.34190/JEL.17.2.04.

Zalavra, E., Papanikolaou, K., Dimitriadis, Y., & Sgouropoulou, C. (2021). Exploring Teachers' Needs for Guidance While Designing for Technology-Enhanced Learning with Digital Tools. In T. De Laet, R. Klemke, C. Alario-Hoyos, I., Hilliger, & A. Ortega-Arranz (Eds). *Lecture Notes in Computer Science: Vol 12884. Technology-Enhanced Learning for a Free, Safe, and Sustainable World. EC-TEL 2021* (pp. 358-362). Springer, Cham. doi:10.1007/978-3-030-86436-1_35.

Zalavra, E., Papanikolaou, K., Dimitriadis, Y., & Sgouropoulou, C. (2023). Representing learning designs in a design support tool. *Education and Information Technology, 28*, 6563–6594 doi:10.1007/s10639-022-11441-6.

Ziglio E. (1996). The Delphi-method and its contribution to decision-making. In M. Adler & E. Ziglio (Eds.), *Gazing into the Oracle. The Delphi Method and its Application to Social Policy and Public Health* (pp. 3-33). London, UK: Jessica Kingsley Publishers.

Appendix 1. Data collection tools

Appendix 1 includes the tools that were used to collect data during the Delphi study and the Case study.

Section A. Delphi study, reports the questionnaires adopted respectively in the first and second round of the Delphi study (see chapter 5):

- First round questionnaire
- Second round questionnaire

Section B. Case study, includes the tools adopted in the case study described in chapter 6:

- Q1 - Pre-training questionnaire
- Q2 - Post training questionnaire
- Q3 - Follow up questionnaire
- Q4 - End of the training questionnaire
- Interviews

A. Delphi Study

First round - Questionnaire

Thank you for agreeing to participate in this first round of the Delphi study. You were asked to participate because we acknowledge your expertise in the field. As you were told in the invitation letter, the study is about the adoption of LD methods and tools, and most specifically about the aspects affecting the decision of adopting LD methods and tools.

We are interested in:

- How you rank the importance of exploring teachers' needs and perceived barriers in understanding the adoption of LD tools and methods (Part A).
- How you rate the importance of the single aspects (namely single needs and barriers) identified through a review of the literature (Part B).

To this aim, we ask you to evaluate the overall perspective and the single aspects. We also ask you to suggest other factors potentially affecting the choice of adopting a method/tool that the conducted review disregarded (Open questions in Part B)

The survey will include rating scales and open-ended questions

Please read the Consent Form that precede the questionnaire itself and formally accept to participate

There are 11 questions in this survey.

Section A: Consent Form

A1. Have you read and understood the information related to the privacy policy hereunder:

We will make our best efforts to maintain confidentiality of any information that is collected during this research study, including any information that can identify you. We will protect your confidentiality by ensuring that there will be no identifying information on any of the data from the Delphi Study. You will be identified by a study ID number. Your study ID number will be associated with your email address which will be kept in a log that will be stored in a password-protected computer file available only to the Research Responsible (RR), dagnino@ itd.cnr.it at the Institute for Educational Technology of the National Research council of Italy. You will need to be contacted by the RR via your email address during the study if you do not respond during the requested time frame between each Delphi round. All data collected will remain confidential.

There will be privacy in gathering, storing and handling data (please read the privacy policy document on <Institutional website>, that was drafted according to the guidelines of the General Data Protection Regulation (GDPR). The data will be kept by the RR for the period required for their processing. After that, all materials will be destroyed.

— Yes
— No

A2. Having read and understood the privacy policy, do you agree to participate in the study

— Yes
— No

Section B: Background Information

B1. What is your background

— Education
— Engineering/informatics
— Both
— Other…….

B2. Years of research in the field of Learning Design ……

Section C - Part A: Needs and barriers to understand adoption

C1. In this section you will be asked to rank the importance (from 1 the most important to 3 the less important) of the following aspects for understanding the lack of adoption of LD tools and methods:

a) teachers' needs …….
b) extrinsic barriers (linked to the context and the specifics of methods and tools) ……
c) intrinsic barriers (linked to personal characteristics and abilities) ....

C2. Please explain why you decided this rank and if you consider one of these aspects not important in understanding adoption

……
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…….

Section D - Part B: Importance of factors in affecting adoption

Hereunder a list of teachers' needs and barriers drawn from a review of the literature will be reported. You are asked to rate on a five-point scale from 1 (Not at all) to 5 (Extremely) how much, in your view, each of them is important and affect/prevent the concrete adoption

Teachers needs

D1. In the following, we will report a list of teachers' needs in relation to LD methods and tools. Please rate on a scale from 1 (Not at all) to 5 (Extremely) how much, in your opinion, each of these needs can affect the LD methods/tools adoption

	Not at all				Extremely
	1	2	3	4	5
1. Flexibility					
2. Support for reuse and adaptation of design					
3. Support for cooperation among teachers					
4. Support for reflection					
5. Easiness of use of tools					
6. Time saving					
7. Availability of specific forms of representations (textual/graphical)					
8. Coherence with the of teachers' design thinking					

D2. Do you envisage any other need that you feel has been disregarded in the list above presented? Please list any need (s) and describe it (them). See examples:

1) The need of....., it deserve to be considered/it is important because...
2) The need of .....

A. ……...
B. ……
C. ……...

Barriers

D3. In the following, we will report a list of barriers (extrinsic and intrinsic). Please rate on a scale from 1 (Not at all) to 5 (Extremely) how much, in your opinion, each of these can affect LD methods/tools adoption

	Not at all				Extremely
	1	2	3	4	5
Extrinsic barriers					
1. Lack of institutional support					
2. Lack of adequate teacher training					
3. Time/workload factors					
4. Conceptual complexity of method and tools					
5. Adoption by peers					
Intrinsic barriers					
1. Use of ICTs in the teaching practice					
2. Motivation					

D4. Do you envisage any other barrier that you feel has been disregarded in the list presented above: Please list any barrier (s) and describe it (them). See example:

1) The ..... it deserve to be considered/it is important because...
2) The .....

A. ……...
B. ……
C. ……...

Section E: End

E1. Please feel free to leave your comments below

……
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……
……

Second round - Questionnaire

This is the second round of the Delphi study about Learning Design adoption. You were asked to participate in this second round because you positively answered to our invitation and participated in the first round.

To remind you the main scope of the study, it is about the adoption of LD methods and tools, and most specifically, about the aspects affecting the decision of adopting LD methods and tools. Therefore, we are interested in:

- How you rank the importance of exploring teachers' needs and perceived barriers in understanding the adoption of LD tools and methods (Part A).
- How you rate the importance of the single aspects (namely single needs and barriers) identified through a review of the literature (Part B). In this second round we added some new aspects resulting from your answers to the open questions in the first round

To this aim, we ask you again to evaluate the overall perspective and the single aspects in the light of the results of the first round, that you are kindly asked to consult before proceeding with the second round

In this second round, we also ask you to suggest possible solutions that you envisage in relation to the highlighted barriers (Open question in Part C)

The survey includes rating scales and open-ended questions.

Please before going forward with the questionnaire consult the results of the first round at this link Results of the first round (https://docs.google.com/document/d/1-mzd37HwHZpc17IEAf2DP_N4U1ZG8-4F53Sw5-SDnn0/edit?usp=sharing)

Please read the Consent Form that precedes the questionnaire itself and formally accept to participate.

There are 13 questions in this survey

Section A: Consent Form

A1. Have you read and understood the information related to the privacy policy hereunder:

We will make our best efforts to maintain confidentiality of any information that is collected during this research study, including any information that can identify you. We will protect your confidentiality by ensuring that there will be no identifying information on any of the data from the Delphi Study. You will be identified by a study ID number. Your study ID number will be associated with your email address which will be kept in a log that will be stored in a password-protected computer file available only to the Research Responsible (RR), dagnino@ itd.cnr.it at the Institute for Educational Technology of the National

Research council of Italy. You will need to be contacted by the RR via your email address during the study if you do not respond during the requested time frame between each Delphi round. All data collected will remain confidential. There will be privacy in gathering, storing and handling data (please read the privacy policy document on <Institutional website>, that was drafted according to the guidelines of the General Data Protection Regulation (GDPR). The data will be kept by the RR for the period required for their processing. After that, all materials will be destroyed.

— Yes
— No

A2. Having read and understood the privacy policy, do you agree to participate in the study

— Yes
— No

Section B: Background Information

B1. What is your background

— Education
— Engineering/informatics
— Both
— Other…….

B2. Years of research in the field of Learning Design ……

Section C - Part A: Needs and barriers to understand adoption

C1. In this section you will be asked rank the importance (from 1 the most important to 3 the less important) of the following aspects for understanding the lack of adoption of LD tools and methods:

a) teachers' needs …….
b) extrinsic barriers (linked to the context and the specifics of methods and tools)……..
c) intrinsic barriers (linked to personal characteristics and abilities).....

C2. Please explain why you decided this rank and if you consider one of these aspects not important in understanding adoption

……
……

……
……

C3. To which of the above-mentioned aspects (teachers' needs, external barriers and internal barriers) should researcher pay more attention in the future?

— Teachers' needs
— External barriers
— Internal barriers

You can select more than one option

Section D - Part B: Importance of factors in affecting adoption

Hereunder a list of teachers' needs and barriers drawn from a review of the literature will be reported. You are asked to rate on a five-point scale from 1 (Not at all) to 5 (Extremely) how much, in your view, each of them is important and affect/prevent the concrete adoption.

Teachers needs

D1. In the following, we will report the list of teachers' needs in relation to LD methods and tools that you have already rated during the first round. Please rate them again, on a scale from 1 (Not at all) to 5 (Extremely) how much, in your opinion, each of these needs can affect LD methods/tools adoption.

	Not at all				Extremely
	1	2	3	4	5
Flexibility					
Support for reuse and adaptation of design					
Support for cooperation among teachers					
Support for reflection					
Easiness of use of tools					
Time saving					
Availability of specific forms of representations (textual/graphical)					
Coherence with the teachers' design thinking					

D2. In the first-round respondents were requested to suggest other possible needs don't taken into account by the proponents of the study. Answers were organized in categories that are reported hereunder. Please rate on a scale from 1 (Not at all) to 5 (Extremely) how much, in your opinion, each of these needs can affect LD methods/tools adoption

	Not at all				Extremely
	1	2	3	4	5
Need of successful examples of designs					
Need of low cost (money and time) solutions					
Need of support to conceptualization/or LD creation					
Need of support to pedagogical creativity					
Need of support to deployment (in technology-based learning environments)					
Need of reward for sharing					
Need of support to orchestration (including maintenance and help desk)					
Need of interoperability among LD tools					

Barriers

D3. In the following, we will report a list of barriers (extrinsic and intrinsic). Please rate on a scale from 1 (Not at all) to 5 (Extremely) how much, in your opinion, each of these can affect LD methods/tools adoption.

	Not at all				Extremely
	1	2	3	4	5
Extrinsic barriers					
Lack of institutional support					
Lack of adequate teacher training					
Time/workload factors					
Conceptual complexity of method and tools					
Adoption by peers					
Intrinsic barriers					
Use of ICTs in the teaching practice					
Motivation					

D4. In the first round respondents were requested to suggest other possible barriers (extrinsic or intrinsic) don't taken into account by the proponents of the study. Answers were organized in categories that are reported hereunder Please rate on a scale from 1 (Not at all) to 5 (Extremely) how much, in your opinion, each of these can affect LD methods/tools adoption

	Not at all				Extremely
	1	2	3	4	5
Extrinsic barriers					
Scarce adherence to teachers'					

needs/practice					
Scarce adaptability of tools to context/curriculum					
Lack of support to orchestration (including maintenance and help desk of deployed designs)					
Negative attitudes of students towards TEL approaches					
Intrinsic barriers					
Lack of confidence with technology					
Lack of creativity					

Section E - Possible solutions

E1. After having considered all the above-mentioned barriers, we ask you suggesting possible solutions that you envisage in relation to any of them.

……
……
……

Section F: End

F1. Please feel free to leave your comments below

……
……
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……
……

B. Case study

Q1 - Pre-training questionnaire

Dear teacher,

we invite you to fill in this questionnaire through which we would like to know the way in which you currently design your teaching.

Processing of personal data

The data entered in the questionnaire will be kept for research purposes and will be processed - in compliance with the provisions of Legislative Decree 196/03 (Privacy) - by the trainers, in order to allow an analysis of the questionnaire itself for educational and research purposes. Any publications based on these data will process them anonymously only.

Current design practice

1. Do you teach the same subject every year?
   Yes/No

2. Do you design the entire course you teach every year?
   Yes/No

3. Do you design part of the course you teach every year?
   Yes/No

4. Think to the process you follow when you design a course from scratch (or part of it). Rank the following elements, from the element that influence/guide you most to the element you that less influence your decisions:
   a. theories about learning (general beliefs about how students learn)
   b. preferred teaching approach (the way I like to teach)
   c. goals of the course overall
   d. learning objectives and competences (what students should learn)
   e. assessment criteria
   f. learning activities (things students need to learn to do)
   g. content I need to cover
   h. resources available
   i. accreditation requirements
   j. subject proposal (established curriculum documents)

k. past experience of similar subjects
l. technologies available (online or other)

5. Do you make use of any support in your design process?
    a. Paper based support
    b. Templates
    c. Mind mapping tool
    d. Learning design tool
    e. Other ……

6. Can you briefly describe the support/tool you use (Open ended)

Use of software tools for LD (conditioned)

7. If you use a software tool for LD, can you tell us the name of the tool? (Open ended)
8. What are the features making this tool useful? (Open ended)
9. Is the tool ease to be used? What can be improved? (Open ended)
10. Is the tool useful? What can be improved? (Open ended)
11. Have you been trained in using this specific tool?
    Yes/No
12. Have you been supported after the initial training?
    Yes/No
13. Do you think that a training could be useful?
    Yes/No

Not conditioned

14. Have you been trained with a specific software tool supporting learning design that you are not using any more?
    Yes/No

If so (conditioned)

15. Can you tell me why you decided not to keep using it (e.g., characteristics of the tool, time, institutional context constraints…?) (Open ended)
16. As to the tool itself, is there a specific obstacle (difficulty) that prevented you from keep using it? (Open ended)

Q2- Post training questionnaire (anonymous)

Dear Teacher,

we invite you to fill out this questionnaire through which we would like to detect your satisfaction with the content and activities carried out during the course.

The questionnaire has 4 parts: A. Evaluation of the course, B. Evaluation of the use of the garden metaphor, C. Experience of using the tool: Pedagogical Planner (only for group A).

(Sections A and B are not reported here being unrelated to the thesis)

Section C: Experience with the tool: Pedagogical Planner

1. Please express your level of agreement from 1 (Not at all) to 5 (Very much) with these statements related to the tool you adopted during the training:

	Ease of use	Not at all				Very much
		1	2	3	4	5
1	The tool is easy to be used					
2	The tool is engaging					
3	The tool is flexible					
4	The tool makes the design process easier					
5	The tool allows to save time					

	Usefulness	Not at all				Very much
		1	2	3	4	5
1	The tool is useful					
2	The tool supported the conceptualization of new (collaborative) activities					
3	The tool allows to represent effectively the pedagogical path					
4	The tool helped considering the elements at play (context, population)					
5	The possibility to describe (in text format) the different elements is useful					
	The graphical representation of the					

6	activity flow is useful					
7	The possibility to describe (in text format) the activities is useful					
8	The tool supported self-reflection					
9	The tool promoted discussion and sharing among colleagues					

	Desirability	Not at all				Very much
		1	2	3	4	5
1	I think that the opportunity to save my design in digital format could be useful					
2	I think that having a digital version of my design could promote sharing					
3	I think that having a digital version of my design could be useful to revise and change the design over the time					

	Sustainability	Not at all				Very much
		1	2	3	4	5
1	I think I will use the Pedagogical Planner in the future to design my teaching activities					
	Why?					
2	I think that the Pedagogical Planner could be used by my colleagues in the future for designing teaching activities					
	Why?					

Q3 - Follow up questionnaire

Dear Teacher,

We invite you to fill out this questionnaire through which we would like to detect whether any of the tools (and related method) you learned during the 'Generation Web' course has become part of your knowledge base and supported you in planning at the beginning and during this school year.

Processing of personal data
The data entered in the questionnaire will be kept for research purposes and will be processed - in compliance with the provisions of Legislative Decree 196/03 (Privacy) - by the trainers, in order to allow an analysis of the questionnaire itself for educational and research purposes. Any publications based on these data will process them anonymously only.

Section A: Current use of the design tool

1. Have you used the Pedagogical Planner (PP) and the related design method introduced during the training 'Generazione Web' for designing the new educational units/pats for the current school year

Never	Sometimes	Often	Always

2. Which of the following factors represented a BARRIER to the adoption of the tool (PP) for designing educational paths (please, indicate three alternatives as a maximum):
   - ☐ My institution does not support the tool adoption
   - ☐ Very few (or no one) of my colleagues use it
   - ☐ The training on the tool was insufficient
   - ☐ The tool is too complex
   - ☐ I make little use of technologies in my teaching practice
   - ☐ Lack of time
   - ☐ I'm not motivated to use it
   - ☐ Other…….

Please motivate your choices…….....

……
…….....

3. What do you think could push or help you adopting the tool?
……
……

4. Have you adopted any other of the method and tools presented during the training 'Generazione Web'? If so, which one?
……
……

Section B: Desirable features in a Learning Design tool

1. Please state your level of agreement [Completely disagree (1) a Completely agree (2)] on the characteristics presented in the following.

	Completely disagree			**Completely agree**	
The tool should	**1**	**2**	**3**	**4**	**5**
Be easy to use					
Be flexible					
Reflect the design culture of the institution (structure and terminology)					
Support the designer in considering all the elements at play (population, context, knowledge domain, etc)					
Support the designer in the description of the elements at play (population, context, knowledge domain, etc)					
Support the graphical representation of the design					
Support design revision and change					
Support reuse and adaptation of my designs					
Support reuse and adaptation of designs from others					
Support collaboration among colleagues					
Allow me to save time					

Q4 - End of the training questionnaire

Dear teacher,

in the last two years you were trained about Learning Design (LD). A specific approach and a tool (Pedagogical Planner) based on this approach were presented and you were asked to adopt them. This survey is aimed at investigating whether the training and the proposed approach have brought changes in your design practice.

Processing of personal data

Data collection and analysis are made in accordance with the EU GDPR 2016/679. All the data will be processed anonymously.

I accept that data provided by means of this questionnaire will be stored exclusively for institutional purposes and will be managed in accordance with Article 13 of the EU General Data Protection Regulation 2016/679. <Institutional website>,

— Yes
— No

Section A: changes in the design practice

1. In general, would you say the training brought any change in your design practice?

□Yes □No

Please briefly motivate your answer

……...……
……
……
……
……

2. During the training a design approach was proposed through the PP. Have you adopted this approach or some aspects of the approach (e.g. the description of the elements - context, population, etc. - that influence the design, the lesson sequencing, etc.) even without using the tool

□Yes □No

3. If so, please select in the list below how the approach influenced your design practice by ticking the box of the item(s) in the list and indicate how frequently you do this. Please feel free to add any other innovation you brought into your LD practice as a consequence of the training.

Tick	Design action	How frequently[1]
	I design the teaching/learning activities more systematically	
	I draft the design on paper	
	I describe the context for which the learning path is designed	
	I describe the population for which the learning path is designed	
	I describe the contents to be addressed in a content map	
	I describe the learning objectives of the learning path	
	I describe the tool/resources to be adopted in the path	
	I represent graphically the sequence of activities in the learning path	
	I describe in text format the sequence of activities in the learning path	
	I describe the single activities in the learning path	
	I revise the design after having carried it out	
	I share my designs with colleagues	
	Other (specify).....	

[1]How frequently: please indicate if 'sometimes', 'often', 'always'

4. If not, please specify why

……
……..……
……
……

5. Do you envisage any advantage in keeping using the PP tool for designing teaching and learning activities?

□ Yes □ No □ I don't know

Why----------
---

6. According to feedback collected in surveys and interviews carried out before, the adoption of the tool was limited. Please indicate what of the following aspects represented a BARRIER to the adoption of the tool (PP) (3 alternatives as a maximum, the most significant ones in your opinion).

Barrier	Description of the barrier	Tick
Lack of institutional support	My institution did not give me enough support to adopt the tool	
Lack of adequate training	The training on the PP wasn't adequate	
Scarce adoption by colleagues	The tool wasn't widely adopted by colleagues	
Conceptual complexity of the tool	The tool is too complex	
Scarce use of ICTs in the teaching practice	My use of ICTs in the teaching practice is scarce	
Time/workload aspects	I can't use it since I do not have enough time (i.e., due to my workload)	
Lack of motivation	I'm not motivated enough to use it in my practice	
Scarce adherence to my needs/practice	The tool does not satisfy my needs/it's not coherent with my practice	
Scarce adaptability of the tools to the context/curriculum	The tool is not flexible enough to be adapted to my context or curriculum	
Lack of confidence with technology	I'm not confident enough with technologies	
Lack of creativity	I'm not creative enough to use it	
Negative attitudes of students towards TEL approaches	Students may have a negative attitude when the design prepared with the PP implies the adoption of technologies in the classroom	
Lack of support to orchestration (including maintenance and help desk of deployed designs)	I do not get enough support regarding maintenance and help desk, when I set and manage the learning designs that I have deployed in the class	
Other (specify)……		

Section B: Jamboard

Last spring you participated in a meeting devoted to reflecting on the teacher training experience after which you identified Jamboard (by Google) as a suitable tool for designing teaching and learning activities.

1. Did you use Jamboard after the meeting?

Never	Sometimes	Often	Always

Afterwards, you got a design task by the trainer to be carried out by using Jamboard.

2. Did you carry out the task?

□Yes □No

If so, in the following questions (4 and 5), we ask you to rate the tool in relation to its ease of use and usefulness.

3. Please rate from "Not at all" (1) to "Very much" (5) the following statements about Jamboard.

	Ease of use	Not at all				Very much
		1	2	3	4	5
1	The tool is easy to be used					
2	The tool is engaging					
3	The tool is flexible					
4	The tool makes the design process easier					
5	The tool allows to save time					

	Usefulness	Not at all				Very much
		1	2	3	4	5
1	The tool is useful					
2	The tool supports the conceptualization of new (collaborative) activities					
3	The tool allows to effectively represent the learning path					
4	The tool helps considering the elements at play (context, population)					
5	The possibility to describe (in text format) the different elements is useful					
6	The possibility to graphically represent the design is useful					
7	The possibility to import files is useful					
8	The tool supports self-reflection					
9	The tool promotes discussion and sharing among colleagues					
10	The tool supports reuse and adaptation					
11	The tool is coherent with the teacher design thinking					

	Sustainability	Not at all				Very much
		1	2	3	4	5
1	I think that in the future I will use Jam-board for designing teaching/learning activities					
	Why?					
2	I think that the Pedagogical Planner could be used by my colleagues in the future for designing teaching activities					
	Why?					

4. Point out two positive and two negative aspects of Jamboard as design tool

.....

.....

.....

Interviews

Informed Consent

You have been invited to take part in an interview via Skype in relation to the Bakery Cafe project.

The interview will be recorded and later transcribed for ease of analysis. We will ask you some questions pertaining to the project. We will collect your biographical data and some information about your education and teaching activities. In no way will data of a sensitive nature (data that may reveal racial and ethnic origin, religious, philosophical, or other beliefs, political opinions, membership in parties, unions, associations or organizations of a religious, philosophical, political or trade union nature, health status and sexual orientation) be collected.

How will your data be analysed and processed? Your data (including audio recording and interview text) will be recorded and kept anonymous.

We will do our best to maintain the confidentiality of information collected during this research study, including any information that may identify you. We will protect your confidentiality by ensuring that there will be no identifying information on any of the data in the study. Interviews will be anonymized and will be stored in a password-protected computer available only to the Research Manager (RR), Francesca Pozzi (pozzi@itd.cnr.it), at ITD-CNR. All data collected will remain confidential. The data will be processed in accordance with European legislation on the protection of personal data. As such, your right to confidentiality will always be respected and no personal data will be disclosed.

I have read and understood the information and agree to participate in the study as part of the Bakery Cafe project. I understand that I will take part in an interview that will be recorded, and that the interviewer will ask me questions about my opinions and views. I understand that my data (including the recording and transcript of the interview) will be registered and kept anonymous and will be analysed solely for the purpose of the above study or similar studies conducted by others. I understand that I do not have to answer all questions and can back out at any time.

☐ I authorize the processing of my personal data in accordance with Legislative Decree June 30, 2003, No. 196 "Code for the Protection of Personal Data" and EU Rego-lament 2016/679, General Data Protection Regulation (GDPR), dated 25/05/2016

Name and Surname _____

Signature_____

Date_____

Interview codebook

1 Codes decided '*a priori*':

Theme	Code	Subcode	Subcode
Teaching subject			
LD			
	Current practice		
	Design usefulness		
PP Tool			
	LD method proposed		
	Ease of use		
		Flexibility	
		User (un) friendliness	
		Time saving/consuming	
	Usefulness		
		Effects on implementation	
		Coherence with Institutional tools	
		Coherence with current design practice	
		Support to reflection	
		Support to reuse	
		Support to collaboration	
			Sharing and reusing
Tools for design			
	LD tools		
	Mind mapping tools		
	Paper form for LD		
	Paper & pencil		

Other codes emerged from the analysis:

Theme	Code	Subcode
LD		
	Design implementation	
	Customization of designs	

	Frequency	
PP Tool		
	Usefulness	
		Guidelines provision
		Context adequateness
Tools adoption	Role of institution	

Appendix 2. Results

Appendix 2 reports the results of the Delphi study and of the case study.

Section A. Delphi study, includes results that are not reported in chapter 5, specifically the full excerpts of the experts as far as the needs and the barriers proposed in the first round (see section 5.3.3) and the solutions to support adoption of Learning Design methods and tools (see section 5.3.4). Excerpts are presented in the following tables:

- Table 1 - Needs proposed by experts in the first round
- Table 2 - Barriers proposed by experts in the first round
- Table 3 - Experts' suggestions.

This section also includes the report of the first round that was shared with experts at the beginning of the second round (see section 5.2.1.2).

Section B. Case study, reports the results under each questionnaire, while in section 6.8.2 and 6.9.2 results are reported under the lens of each issue, topic, or informative question. In the followings:

- Q1 - Pre-training questionnaire – first iteration
- Q2 - Post-training questionnaire – first iteration
- Q3 - Follow-up questionnaire - first iteration
- Interview results - first iteration
- Analysis of the designs (PP) – first iteration
- Analysis of the designs (Jamboard) – second iteration
- Q4 - End of the training questionnaire – second iteration.

A. Delphi Study

Table 1 – Needs proposed by experts in the first round

Needs	*Excerpts*
Need for support for deployment	"*The need to translate designs into technological tools (e.g., Moodle) that support them. I believe that highlighting the mapping that instructional designs have with their technological support can favour their adoption"*
	"Moreover, these tools should be integrated in the technological systems, VLEs and/or social media teachers use on a daily basis"
	"*The need of connecting with learning tools they use to support the activities and other aspects of their context because they see the practical and direct us of the designs"*
	"*At tertiary level, the need to easing the enactment of a learning design at a learning management platform"*
	"The need design to be linked with virtual learning environments (e-classrooms) actually used by teachers"
Need for support of learning analytics informing Learning Design	*"Not sure it can be labelled a "LD need", but having some kind of data gathering (e.g., of student outcomes, of participation, etc.) mapped and visualized onto the LD can be very useful, both during the enactment and for later reflection and redesign"*
Need for support for orchestration	*"It can also be important to have some kind of "enactment support" in the sense of having a (simplified) visualization of what was planned and the current time, so that the teacher can track deviations"*
	"Need for someone that solves technological problems at school the need for someone that solves technological problems for students when they use technology at home"
Need for interoperability among Learning Design tools	"*Interoperability/translation between LD tools can be quite important once the routine of doing LDs is internalized - so that I can take my designs made with one tool, to another tool that may be in use in a different context/team, etc. (although probably teachers themselves are not aware of this kind of need)"*
	"The co-designing of the tools might be of great help to promote the adoption of any LD tool"
	"Interoperability: ease of two-way synchronization between LD tools and orchestration / enactment / delivery platforms, ease of exporting and importing content from the LD tool struc-

	tured review and approval workflow, dynamic multi-resolution design: easily flow back and forth between high-level and detailed design"
Need for support for conceptualization/or creation of learning designs	*"Support for creating a design - important because teachers are more likely to create a new design than to adapt and reuse an existing one. Also, different thought processes are involved in creation vs adaptation/reuse"*
Need for low costs solutions	*"The need to keep costs as low as possible for the teacher, in terms of both money and the time it will take the teacher to adopt the new LD tool"*
Need for examples	*"One factor (even if it is not a need) that could influence adoption is having tried out (as a student or - at least - as a witness) a model and perceived it works. This is a kind of reuse, but not reuse of a design, rather, it is reuse of a model. I see an example, I like it, I abstract a schema and re-apply the schema. So, I do not start from a design, but from a concrete example. This is the same that happens when teachers apply the same methods that have been used with them, over and over again. It has worked with them, so they believe it will work with their students. We could call it a need for examples"*
Need for reward for sharing	*"If the context provides a reward for sharing Learning Design among teachers (such as using each other's designs so as to save on preparation time), then this encourages this approach. However, many academics work in a "solo" way in their courses, so there is little reason for them to share"*
Need for support for pedagogical creativity	*"The need of tools supporting pedagogical creativity"*

Table 2- Barriers proposed by the experts in the first round

Barriers	*Excerpts*
Extrinsic - Lack of support to orchestration	*"Lack of leadership. It deserves to be considered because someone must be supporting questions and problems that appear in the implementation"*
Extrinsic - Scarce adaptability of the tools	*"A different barrier I see has to do with the alignment of the LD tools provided, and the particular characteristics of the curriculum. For the adoption of LD tools, teachers should be able to customise or adapt them to the language, conceptual structure and requirements of the official curriculum they are implementing. So, LD tools should be flexible enough to be adapted to different curriculum requirements in different parts of the world"*
Extrinsic - Scarce adherence to teachers' needs/practice	*"Compatibility with teachers' work practices: we should start from ethnographic analysis of how teachers currently conduct their (tacit) design work, and build the tools around that so as to draw them in by offering clear and immediate potential for time saving, and gradually introduce the concepts and practices of LD"*
	"The design of the tools could consider more the participation of teachers using co-design or participatory design methods so that they are closer to their mindsets and needs".
Extrinsic - Negative attitudes of students towards Technology Enhanced Learning (TEL) approaches	*"Negative attitudes of students towards certain TEL approaches (I have seen students who did not like collaborative learning, or learning by doing, or Game based learning...)"*
Intrinsic - Lack of creativity	*"Lack of creativity. It deserves to be considered because an innovative scenario could be imagined.*
Intrinsic - Lack of confidence	"*Confidence and willingness to take risks*"
	"*Lack of confidence with technology could be a barrier to the use of tools"*

Table 3 – Experts' suggestions

Suggestion	*Excerpts*
Training/informative actions for teachers and headmasters	*"Lack of motivation is a combination of lack of awareness of the need for LD solutions and extrinsic barriers. This can be solved through the training of both teachers and headmasters".* *"Institutions could build learning design principles and practices into professional developments courses for beginning teachers and in-service teachers. Activities should initially use low-tech materials, as in the xxx workshops run by xxx".* *"I think that all the stakeholders need to be involved, starting from informing institutions about the potential of designing and then empowering teachers through training to do so".* *"It's needed teamwork, real problems to solve, a community of practitioners and continuous training as a way to support uses, to offer context to LD, to enhance intrinsic feelings and to reduce extrinsic problems".*
Sharing and reusing experiences (success stories, templates…)	*"Lack of motivation is a combination of lack of awareness of the need for LD solutions and extrinsic barriers. This can be solved through […] but also through the dissemination of information about learning design success stories".* *"For the main barriers I consider (lack of time/workload, and lack of perceived added value), I think any solution passes through some sort of "template reuse". If the templates are easily implementable in the classroom (e.g., automated deployment and orchestration support), robust/flexible enough (no technical glitches, work in teacher's particular context with minimal customization), and they are rich enough to provided added value over classic non-explicit planning (e.g., useful analytics tailored to the design, etc.), then MAYBE teachers would use such solutions".* *"I suggest exploring new methods for sharing, adoption and adaptation of learning designs"* *"New designs that not only have to be proposed and favoured but also institutionally supported, without neglecting the keys to teaching work such as collaboration with other colleagues. In summary, it is a set of factors that interact allowing or inhibiting the incorporation of new innovations".*
More mature tooling	*"Another barrier is the unavailability of solid tools and methods that are free and easy to use for teachers. This can only be solved if some of the existing prototypes become extensively usable. This can be achieved with appropriate collaborations*

	between researchers and developers who can transform the prototypes in widely usable tools".
	"The LD tools are not yet adequately developed to support the 'messiness' of the initial stages in the design process (with the exception of LAMS, which sadly appears to be in decline)".
	"For the main barriers I consider (lack of time/workload, and lack of perceived added value), I think any solution passes through some sort of "template reuse". If the templates are easily implementable in the classroom (e.g., automated deployment and orchestration support), robust/flexible enough (no technical glitches, work in teacher's particular context with minimal customization), and they are rich enough to provided added value over classic non-explicit planning (e.g., useful analytics tailored to the design, etc.), then MAYBE teachers would use such solutions".
Ensure institutional support	*"There is an overhead when adopting a new tool or changing practice and institutions need to acknowledge that offer support and motivation".*
	"As noted for research question - different kinds of solutions are needed for different issues - extrinsic issues are mostly issues of lack of institutional support (which can appear as a failure to address issues of strategy, workload, technology integration, etc) - these can be solved about an institution which makes a strategic commitment to adoption of LD (such as XXX & LKC in XXX)".
	"A particular problem area is that there may be no institutional support (extrinsic) for such sharing. This is a barrier, because it means that teachers often work in isolation or have difficulty sharing - there may be no technology supports for sharing and few if any policies and practices that create a culture of sharing within workgroups".
	"[…] New designs that not only have to be proposed and favoured but also institutionally supported, without neglecting the keys to teaching work such as collaboration with other colleagues. In summary, it is a set of factors that interact allowing or inhibiting the incorporation of new innovations".
	"Augment the teachers' motivation with endorsement of academic governance of innovation in teaching and with recognition (in term of carrier advancement) of the teachers' involvement".
Participatory design	*"We need a large-scale effort of participatory design of LD tools. Such a project will expose the true barriers (i.e., not just the educated guesses of respondents to this survey) and identify viable solutions for them".*

	"Regular teachers should always be involved in the process of generating new LD tools and methods, and in the evaluation of existing ones. Designing them from the Ivory tower of academia and research teams is not going to help them adopt and use the tools we develop".
Support for reflection on enacted designs	*"For the main barriers I consider (lack of time/workload, and lack of perceived added value), I think any solution passes through some sort of "template reuse". If the templates are easily implementable in the classroom (e.g., automated deployment and orchestration support), robust/flexible enough (no technical glitches, work in teacher's particular context with minimal customization), and they are rich enough to provided added value over classic non-explicit planning (e.g., useful analytics tailored to the design, etc.), then MAYBE teachers would use such solutions".*
Reverse engineering	*"Another solution is to do "reverse-engineered learning design": formalize a LD automatically from data gathered during the enactment (sensors, log data, etc.). If the cost/effort of these solutions is low enough, and the "extracted designs" are expressed in a way that is meaningful for teachers, the value of LDs for reflection can be reaped (just, not before the lesson, but after it)".*
Alignment with teachers' and institutional needs	*"Building tools that are more aligned with teachers' practical needs (e.g., flexibility, provision of design ideas relevant to them - as examples or hints in tools) and institutional requirements (e.g., documenting student's expected workload in the learning design to be considered together with other designs so the institutions value the use of learning design tools)".*
Building teachers' communities	*"An issue quite important is working with groups of teachers aiming to building communities that design together and share ideas & ready designs".* *"It's needed teamwork, real problems to solve, a community of practitioners and continuous training as a way to support uses, to offer context to LD, to enhance intrinsic feelings and to reduce extrinsic problems".*
Work on the interplay of the three categories of factors	*"These factors don't exist in isolation of course, so it would be fruitful to study the interplay between teachers' needs, intrinsic and extrinsic factors, to identify what emergent phenomena arise".*

Dear respondents,
during the First Round of the study, you were asked to:

A. Rank the importance of 3 factors (teachers' needs, extrinsic barriers and intrinsic barriers) in order to understand the adoption of LD tools and methods (Part A)
B. Rate the importance of single needs and barriers (extrinsic and intrinsic) identified through a review of the literature (Part B)

The answers of all the experts involved have been analysed and the results are presented in the following. It's really important that you take a look at them before proceeding with the second round.

A. Needs and barriers to understand adoption of LD tools and methods

In the First Round, you were asked to rank the importance (from 1 -the most important- to 3 -the less important-) of 3 factors (teachers' needs, intrinsic and extrinsic barriers) for understanding the lack of adoption of LD tools and methods.

The panel's answers (20, in all) are distributed as it follows (see Figure 1).

Rankings were analysed using the standard Case V Thurstone scale estimation procedure (Thurstone, 1927). The measure is not absolute but puts one element in relation to the others. Figure 2 represents the relative importance of the three aspects.

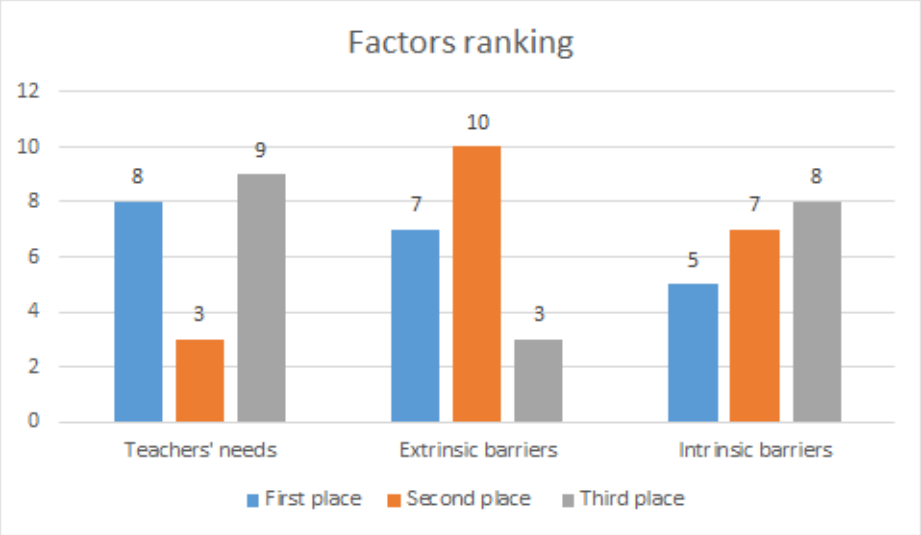


Figure 1 - Answer distribution: number of respondents that put each factor at the first, second and third place in the rank (e.g., first place=1=most important)

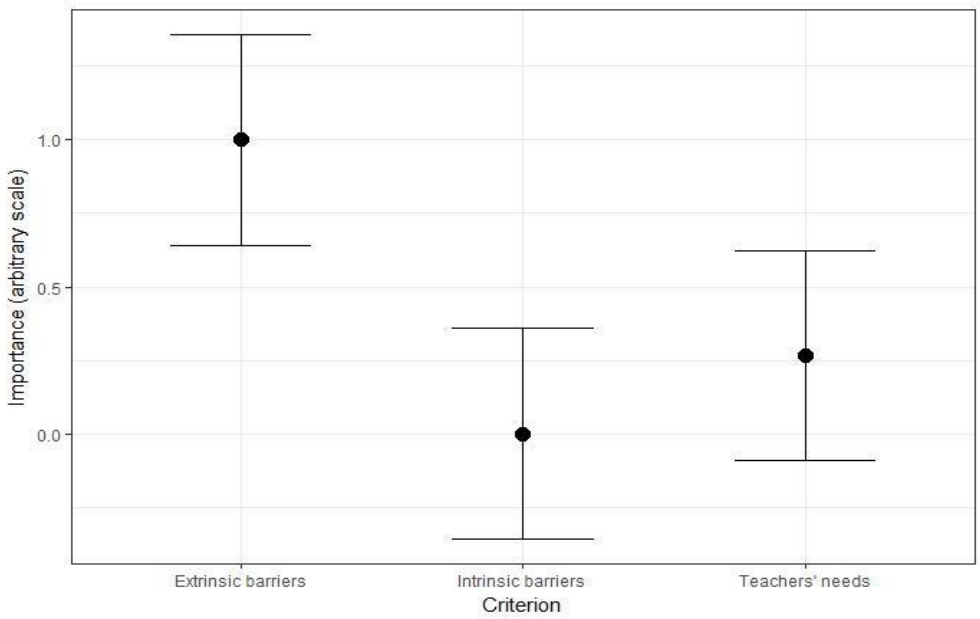


Figure 2 - Relative importance of the aspects with 95% confidence intervals, as estimated by Thurstone Scaling Case V

As you can see, “Extrinsic barriers” were considered more important than “Teachers’ needs” and “Intrinsic barriers”. Nevertheless, most of the respondents in the open-ended question, where you were asked to motivate the ranking, dedicated considerable attention both to intrinsic barriers and teachers’ needs.

Moreover, after having analysed the given answers, we believe that it’s necessary to state how factor “Teachers’ needs” is intended by the proponents of this study.

Below, we re-formulate the definitions of the three factors, together with the specific issues that were detected in the first round. Thus, we aim at clarifying the concepts, as they were defined by the proponents, and avoid eventual misunderstanding between proponents and respondents, during this second round:

- Teachers’ needs: with the factor teachers’ needs we refer to the needs that teachers may have in relation to the methods and the features/affordances of the tools
- Extrinsic barriers: this factor relates to barriers originated in the context in which the teachers work (e.g., lack of support of the institution, lack of training, time constraints) or linked to the proposed tool or method (e.g., conceptual or technical complexity)
- Intrinsic barriers: this factor was linked to individuals in terms of habits, beliefs, abilities. We include under this factor the elements that can affect motivation, i.e., curiosity, personal relevance, awareness of needs.

B. Importance of factors in affecting adoption of LD tools and methods

A list of single teachers’ needs and barriers drawn from a review of the literature (Dagnino et al., 2018) was also proposed in the First Round. You were asked to rate on a five-point scale from 1 (Not at all) to 5 (Extremely) how much, in your view, it affects/prevents the concrete adoption of LD tools and methods by teachers.

The results of the panel’s evaluation are shown next in Table 1 (teachers’ needs), and Table 2 (barriers)

Teachers’ needs

As you can see in Table 1, the factors getting the highest evaluation are: the easiness of use of a tool, the possibility given by the method or the tool to save time in the design phase (that can be considered a concept intertwined with the easiness of use), the capability of the tool to support reuse and/or adaptation of already existing designs, and finally the coherence of the method (or tool) with the teachers’ design thinking.

Table 1 -Teachers' needs: means, standard deviations, maximum and minimum value assigned by respondents. In red the factors getting a mean above 4

Need	Mean	St dev	Min	Max
Flexibility	3,9	1,02	2	5
Support for reuse and adaptation	**4,2**	**0,95**	**2**	**5**
Support for cooperation	3,5	1,19	1	5
Support for reflection	3,35	0,81	2	5
Easiness of use	**4,5**	**0,89**	**2**	**5**
Time saving	**4,45**	**0,94**	**2**	**5**
Form of representation	3,65	1,09	2	5
Coherence with the teachers' design thinking	**4,1**	**1,02**	**2**	**5**

Since were asked to suggest needs beyond the ones proposed, almost all the respondents suggested possible needs, that were organized in the following categories that you will be asked to evaluate in the second round of the Delphi

- Need of support for deployment (in technology-based learning environments)
- Need of support of learning analytics informing LD
- Need of support for orchestration (including maintenance and help desk)
- Need of interoperability among LD tools
- Need of support for conceptualization/or LD creation
- Need of low cost (money and time) solutions
- Need of successful examples of designs
- Need of reward for sharing
- Need of support for pedagogical creativity

Barriers

Table 2 shows that the barriers considered as affecting more the decision of adopting are extrinsic; in particular "Time and workload factors" got the highest mean evaluation followed by the "Lack of institutional support" and the "Lack of an adequate training". These findings are coherent with what was stated by the respondents in the first open question.

Table 2 - Barriers to adoption: means, standard deviations, maximum and minimum value assigned by respondents. In red the factors getting a mean above 4

Barrier	Mean	St dev	Min	Max
Lack of institutional support (extrinsic)	**4,15**	**0,99**	**2**	**5**
Lack of adequate teacher training (extrinsic)	**4,05**	**1,05**	**1**	**5**
Time/workload factors (extrinsic)	**4,45**	**0,94**	**2**	**5**
Conceptual complexity of method and tools (extrinsic)	4	0,73	3	5
Adoption by peers (extrinsic)	3,75	0,85	2	5
Use of ICTs in the teaching practice (intrinsic)	3,35	1,31	1	5
Motivation (intrinsic)	3,95	1,32	1	5

Again, almost all the respondents proposed barriers other than the one listed by the proponents of the Delphi. We organized these barriers in the following categories:

- Extrinsic - Lack of support to orchestration (including maintenance and help desk of deployed designs)
- Extrinsic - Scarce adaptability of the tools to context/curriculum
- Extrinsic - Scarce adherence to teachers' needs/practice
- Extrinsic - Negative attitudes of students towards TEL approaches
- Intrinsic – Lack of creativity
- Intrinsic – Lack of confidence

In this second round you will be requested to evaluate also these suggestions.

Dagnino, F. M., Dimitriadis, Y. A., Pozzi, F. , Asensio-Pérez, J. I. and Rubia-Avi, B. (2018), Exploring teachers' needs and the existing barriers to the adoption of Learning Design methods and tools: A literature survey. Br J Educ Technol, 49: 998-1013. doi:10.1111/bjet.12695

Thurstone, L. L. (1927). A Law of Comparative Judgments. Psychological Review, 34, 273-286. https://doi.org/10.1037/h0070288

B. Case Study

Q1 - Pre-training questionnaire

	Yes	No
1. Do you teach the same subject every year?	4	1
2. Do you design the entire course you teach every year?	4	1
3.Do you design part of the course you teach every year?	1	/

4. Think to the process you follow when you design a course from scratch (or part of it). Rank the following elements, from the element that influence/guide you most to the element you that less influence your decisions.

Teacher		*T1*	*T2*	*T3*	*T4*	*T5*
Ranking	*1*	Goals of the course overall	Goals of the course overall	National Curriculum	Educational approach	Goals of the course overall
	2	Learning objectives and competences	Learning objectives and competences	Learning objectives and competences	Contents of the subject	Learning objectives and competences
	3	Educational approach	Contents of the subject	Goals of the course overall	Reference Learning theory	Reference Learning theory
	4	Reference Learning theory	Educational approach	Learning activities	Learning activities	Contents of the subject
	5	Learning activities	Previous experiences	Contents of the subject	Technologies available	Learning activities
	6	Technologies available	Reference Learning theory	Reference Learning theory	Available resources	Available resources
	7	Available resources	Available resources	Educational approach	Previous experiences	Technologies available
	8	Previous experiences	Technologies available	Previous experiences	Evaluation Criteria	Previous experiences

9	Contents of the subject	Learning activities	Technologies available	Goals of the course overall	Evaluation Criteria
10	Evaluation Criteria	Evaluation Criteria	Available resources	Learning objectives and competences	Educational approach
11	National Curriculum	National Curriculum	Evaluation Criteria	National Curriculum	National Curriculum

5. Do you make use of any support in your design process?
   1. Paper based support **(3 respondents)**
   2. Templates **(4 respondents)**
   3. Mind mapping tool **(1 respondent)**
   4. Learning design tool **(1 respondent)**
   5. Other ……..

6. Can you briefly describe the support/tool you use

T2: Textbooks

<u>Use of software tools for LD (conditioned)</u>

7. If you use a software tool for LD, can you tell us the name of the tool?

T5: "Keynote"

8. What are the features making this tool useful?

T5: "The graphic interface"

9. Is the tool ease to be used? What can be improved?

T5: "Very easy"

10. Is the tool useful? What can be improved?

T5: "It is very useful: it allows a very clear view of the information on the single slides and the insertion of multimedia contents".

11. Have you been trained in using this specific tool?

T5: "No"

12. Have you been supported after the initial training?

T5: "No"

13. Do you think that a training could be useful?

T5: "No"

<u>Not conditioned</u>

14. Have you been trained with a specific software tool supporting learning design that you are not using any more?

T2: "Yes"

If so (conditioned)

15. Can you tell me why you decided not to keep using it (*e.g. characteristics of the tool, time, institutional context constraints*…?)

T2: "Was a tool for another Institution"

16. As to the tool itself, is there a specific obstacle (difficulty) that prevented you from keep using it?

Q2- Post training questionnaire (anonymous)

Section C: Experience with the tool: Pedagogical Planner

1. Please express your level of agreement from 1 (Not at all) to 5 (Very much) with these statements related to the tool you adopted during the training:

	Ease of use	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	**2**	**3**	**4**	**5**		
1	The tool is easy to be used	0	2	5	3	1	3.27	.90
2	The tool is engaging	1	2	7	1	0	2.73	.79
3	The tool is flexible	1	1	3	5	1	3.36	1.12
4	The tool makes the design process easier	2	2	6	0	1	2.64	1.12
5	The tool allows to save time	3	3	4	0	1	2.36	1.21

	Usefulness	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	**2**	**3**	**4**	**5**		
1	The tool is useful	0	3	6	1	1	3	.89
2	The tool supported the conceptualization of new (collaborative) activities	1	3	1	6	0	3.09	1.14
3	The tool allows to effectively represent the pedagogical path	0	2	5	4	0	3.18	.75
4	The tool helped considering the elements at play (context, population)	0	1	4	4	2	3.64	.92
5	The possibility to describe (in text format) the different elements is useful	2	1	5	1	2	3	1.34
6	The graphical representation of the activity flow is useful	1	1	4	5	0	3.18	.98
7	The possibility to describe (in text format) the activities is useful	2	1	4	4	0	2.91	1.14
8	The tool supported self-reflection	1	1	3	6	0	3.27	1.01
9	The tool promoted discussion and sharing among colleagues	1	1	1	6	2	3.64	1.21

	Desirability	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	**2**	**3**	**4**	**5**		
1	I think that the opportunity to save my design in digital format could be useful	0	2	4	3	2	3.45	1.04
2	I think that having a digital version of my design could promote sharing	0	2	3	4	2	3.55	1.04
3	I think that having a digital version of my design could be useful to revise and change the design over the time	0	1	4	4	2	3.64	0.92

	Sustainability	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	**2**	**3**	**4**	**5**		
1	I think I will use the Pedagogical Planner in the future to design my teaching activities	2	2	5	2	0	2.64	1.03
2	I think that the Pedagogical Planner could be used by my colleagues in the future for designing teaching activities	1	3	4	3	0	2.81	0.98

Q3 - Follow up questionnaire

Section A: Current use of the design tool

1. Have you used the Pedagogical Planner (PP) and the related design method introduced during the training 'Generazione Web' for designing the new educational units/pats for the current school year

Never	Sometimes	Often	Always
3	1		

2. Which of the following factors represented a BARRIER to the adoption of the tool (PP) for designing educational paths (please, indicate three alternatives as a maximum):

- My institution does not support the tool adoption
- Very few (or no one) of my colleagues use it (**3 respondents)**
- The training on the tool was insufficient **(2 respondents)**
- The tool is too complex **(1 respondent)**
- I make little use of technologies in my teaching practice
- Lack of time **(2 respondents)**
- I'm not motivated to use it **(1 respondent)**
- Other…….

Please motivate your choices:

T4: "Our time is short, and we can't dedicate adequate time to designing our lessons".
T1: "The radical change of the school organization has stolen energy to teaching design".
T3: "Lack of motivation of the teacher, due to the organization of work".

3. What do you think could push or help you adopting the tool?

T1 and T3: "Concrete examples of plans in my discipline".
T4: "Greater flexibility, easiness of use".
T1: "Colleagues adoption".

Section B: Desirable features in a Learning Design tool

1. Please state your level of agreement [Completely disagree (1) a Completely agree (2)] on the characteristics presented in the following.

	Completely disagree				**Completely agree**	**Mean**	**St.dev**
The tool should	**1**	**2**	**3**	**4**	**5**		
Be easy to use	0	0	0	0	7	5	0
Be flexible	0	0	0	1	6	4.9	.4
Reflect the design culture of the institution (structure and terminology)	0	0	2	2	3	4.1	.9
Support the designer in considering all the elements at play (population, context, knowledge domain, etc)	0	0	1	3	3	4.3	.8
Support the designer in the description of the elements at play (population, context, knowledge domain, etc)	0	0	2	3	2	4	.8
Support the graphical representation of the design	1	0	1	3	2	3.7	1.4
Support design revision and change	0	0	2	2	3	4.1	.9
Support reuse and adaptation of my designs	0	0	0	2	5	4.7	.5
Support reuse and adaptation of designs from others	0	0	0	4	3	4.4	.5
Support collaboration among colleagues	0	0	0	3	4	4.6	.5
Allow me to save time	0	0	0	1	6	4.9	.4

Results were organized according with the code schema presented in Appendix 1. Data collection tools.

A. Learning design

Teachers were firstly interviewed about their design **current practice**

For years, the school have asked teachers to prepare what they call 'micro-planning', that is basically the description for each unit of learning in terms of knowledge, abilities and competences. Moreover, teachers are required to calendarize their teaching. To carry out this task teachers were given a software tool.

One of the interviewees referred only to the microplanning; another identified two levels, the microplanning and the daily design, saying that often she/he tries to match ideas of transversal activities (like the school newspaper) with the units of learning envisaged in the microplanning. The third described a sort of template that she/he usually adopts for organizing the single lessons, that he/she attributed to the method delivered through the PP but that reflects more a template for organizing the phases of a collaborative activity.

A topic emerging from the interviews was the **effect of designing on implementation;** the two teachers who referred to the microplanning highlighted that what happens in class may diverge from what was planned, due to changes in the calendar or what happens during the lessons, but that they do not come back to 'micro' for reporting changes or reflecting on the schedule they prepared.

"So, I tend to fill in the 'micro' at the beginning of the year and then I try to … address those topics or at least refer to those topics during the lesson, then if the lesson takes a different direction, I cannot transcribe any time these things on the micro here…because really…

INT: Yes, it's an extra job

T1: It is more work that should always be done, but it should results from... following a reflection… here it is always the point I return to, devote adequate time on reflection… like […]" (Teacher 1)

The last teacher, who refer to this sort of fix template for preparing lessons, similarly reports that:

"Here there are continuous interruptions, either because of the nature of the students… so from the inside, either ... repeatedly and often it happens, I am interrupted from the outside. People who come in, like the secretary, tutor number 1 or the number 2… I always have people coming in. [] the nature of the lesson can often be compromised". (Teacher 3)

The lack of predictability of the lessons seems to also affect the perceived **usefulness of designing.** Two out of the three teachers were negative, highlighting that plan are often disregarded:

"I find it is a ... lack of a better word ... a waste of time in the sense that the lesson that lies ahead is always unknown from the point of view of what will happen; so you schedule your lesson, with an hourly scan: for 10' minutes I do this, 20 minutes I do that, one quarter I do another thing… and after 5 minutes of lessons everything is already to be thrown away, because it's never like this [...]" (Teacher 2)

Another point that emerges from the interviews is the **level of customization of their designs;** two out of the three teachers declared to tailor (or at least to try to) the design to the different classes in terms of type of activities and resources to propose. For example, teacher 1, shared some reflections about the suitability of the activity (s)he conceived for the class in which was deployed. The third apparently stick to a format (a collaborative activity) for all the classes, with a rigid sequence. When asked about the usefulness of this fix template, the teacher identified limits in the context and not in her/his procedure.

Just one teacher referred to the **Frequency** of the design, telling: "*I try to design as much as possible my teaching even if often it is not possible for reasons linked to the work itself, in the sense that we are often called upon to do other activities apart from designing"*. (Teacher 3)

B. Tools for design

Teachers were asked to describe which tools they adopt for designing teaching/learning activities.

The school provided the teachers with a software for carrying out what they call 'microplanning', two of the three teachers cited the software tool as a mean to design.

When asked how they approach the 'day by day' design two of them said that sometimes they draft it on paper, the third stated to have (or build) the design in mind and then search for resources.

One of them, declared that what he/she designs is not always linked with the microplanning:

"Yes, a piece of paper…I draft it, I like sketching on paper and then I try to connect… sometimes the idea is not linked with the microplanning". (Teacher 1)

C. The PP tool (perception and adoption)

Part of the interview was devoted to deepening the experience with the Pedagogical Planner tool.

LD method

One aspect is that the tool conveys a method for planning that can be adopted even without using the tool. Two out of three teachers expressed appreciation for the proposed method

"[…] Now that I have in mind the flash of the class description I realize that those variables are important to consider, this tool put them there, imposed them on us, made them present every time and maybe now, that is, if you don't use it ... how I work now… sometimes I don't take it into consideration, I don't write down: second year, class composed of…, these difficulties, adequate strategies, recommended…these are things that are.. maybe they are useful, they can also involve tutors in reflection […].

INT: Okay, so it could be useful in terms of framing the class and the strategies that work in that class

T1: Yes, the variables it makes consider are things to keep in mind, yes we should treasure it more". (Teacher 1)

The opinion about tool **flexibility** were divergent, with one considering the tool flexible while a second not. The third did not state a clear opinion about the issue

Ease of use

On the other end, the 3 teachers agreed on the fact that the tool is **not user friendly**

"I find it a little cumbersome ... I don't know […]". (Teacher 2)

"Cumbersome, as it's not user-friendly, fields are in different pages, so I have to go and pick up […]. The colleague and I spent five hours going back to where we were and often we were wrong, we closed the windows in the wrong way ... we didn't reopen in the right way ... that is, it was a mess not indifferent…and since I was at the PC I know well what it cost me effort. [Laughs]. Probably is a matter of practice, maybe with a constant use one practices up". (Teacher 3)

"I realize that the maximum of 'user friendly' does not exist ... it must be something you understand at once, very graphic and then there is the graphics […] graphically design requires minds able to pass a concept quickly. For sure the graphical part, that allows to understand quickly, here lacks and there are limitations in programming". (Teacher 1)

and designing with it is also considered **time consuming**

"It really takes a huge amount of time, I struggle, […] you pass preparing theses schemas three times as long the time you pass in class. I tell honestly… I don't". (Teacher 2)

"The model is effective, but the tool requires to be compiled online that takes many hours, this breaks down enthusiasm". (Teacher 3)

Usefulness

Two out of three teachers stated that using the tool for designing **did not affect implementation,** while the third was more positive

"Yes I would have done the same things even without it; in fact, I got the impression that I had a clear idea at level of implementation, and I met difficulties in expressing it in there (The PP)". (Teacher 1)

"INT: Do you think that having forced you to think about all these things [population, context, etc.] helped to carry out these lessons or the same as usual?

T3: Being forced to think about all the parameters involved, in my opinion everyone was helped. There we plan lessons more effectively, surely". (Teacher 3)

The issue **coherence with institutional tools** was not immediately clear for the teachers. The relation between the microplanning and the PP was not evident for them. After clarifications, the answers focus on the fact that both represent a sort of guide.

"Yes yes, in the sense that you keep it (the microplanning tool) as a base and from there develop various things ... lessons, topics, knowledge, skills ... let's say that for us it is a sort of program drawn up that you readjust, gradually". (Teacher 2)

As to the c**oherence with teachers design practice,** answers vary a lot from one teacher to another; the tool was considered partially coherent by Teacher 3, not coherent by Teacher 2 while Teacher 1 stated that he/she usually designs differently but concluded that the question made him/her reflect on the advantages of considering the aspects highlighted by the PP and the related method.

"I do it in another way but now that the flash of the whole description of the class comes to mind, I realize that those variables are important to have in mind; this tool put them there, imposed them on us, made them present to us every time". (T1)

Teachers did not consider that the tool specifically **support reflection.** Two out of the three stated that they did not come back to the design autonomously to reflect on it; one of them said that it might support reflection, but the same can be said for a design sketched on a piece of paper. The other highlighted that reflection should emerge from the collaboration with colleagues.

"Everything can be, even my pieces of paper". (Teacher 3)

The same is said for the **support to reuse,** all the teachers did not recognize to the tool an added value in this sense. None of them reused the design produced and again one teacher state to consider paper drafts a potential support:

"Sure, but my sheets too…I have a paper archive from the 70s / 80s with plastic sheets, I put inside it what is my planning with a photocopy of the necessary resources or the link of the resource online required". (Teacher 3)

Another question was related to the capability of tool to **support collaboration**, even though teachers adopted the tool for a collaborative task (designing a

shared lesson) they expressed doubts about the capability of the tool to support collaboration. The reasons are [1] the complexity of the tool and [2] the pre-existing lack of collaboration among the teachers.

"*Then, perhaps the thing the PP wanted to do is to get colleagues to collaborate. But I doubted about virtual/digital collaboration [...] Given the digital tool and since there is no real material collaboration before, in the absence of that one, the tool in my opinion is not usable*". (Teacher 1)

But one of them, during the interview, recognized advantages in terms of sharing:

"But you broaden my horizon, also thinking outside the Institution in which I work, if the PP allows me to share or access interventions of other teachers who upload them, this is interesting […]." (Teacher 1)

A couple of topics emerged from the analysis of the interviews:

One teacher considers the tool (and the design method) **not adequate to the context;** according to him/her the context is not comparable to a more traditional one, since lessons implementation often imply changes on the fly due to changes in the calendar, frequent interruptions, students' misbehaviour.

Another appreciated the capability of the tool to **provide guidelines** in the process of designing.

"I saw it more as a guide: remember that the class is like this, remember that there is a first phase in which you do this, remember that there are dynamics that can be set, that there is a final phase…". (Teacher 1)

Tool adoption

Teachers did not express the intention to adopt the tool spontaneously**. The Institution** was cited by two of them as having a role in the adoption. One highlighted that he/she hoped the Institution wouldn't have asked them to use it, the second told as follows:

"Let's say, if the Institution ask us to use this tool one takes some time [INT: sure] otherwise I take what I can steal from the PP and I put it in… I organize it in a Google doc... in case, I link it to the lesson ... It's like this". (Teacher 1)

"*The PP can be useful for planning, but I won't hide the fact that even I, who am the most dutiful…, they told me to use it and I used it...then I couldn't be steady…".* (Teacher 3)

Analysis of the designs (PP)

Teachers were invited to design with one or more colleagues a unit of learning. Four out of six teachers designed collaboratively for a total of two designs that we call Design A and B.

1. Design A: tackles the Creative Commons licences and was developed by the Geography and Economy teacher (T14) and the Informatics teacher and graphics lab (T1)
2. Design B: tackles food labels and nutritional descriptions. It was developed by the Nutrition (T2) and English teachers (T3)

Teachers were told to fill in in details the conceptualization section and to draw the sequence of activities. They were let free to describe each activity to the level of detail they considered useful.

Design A

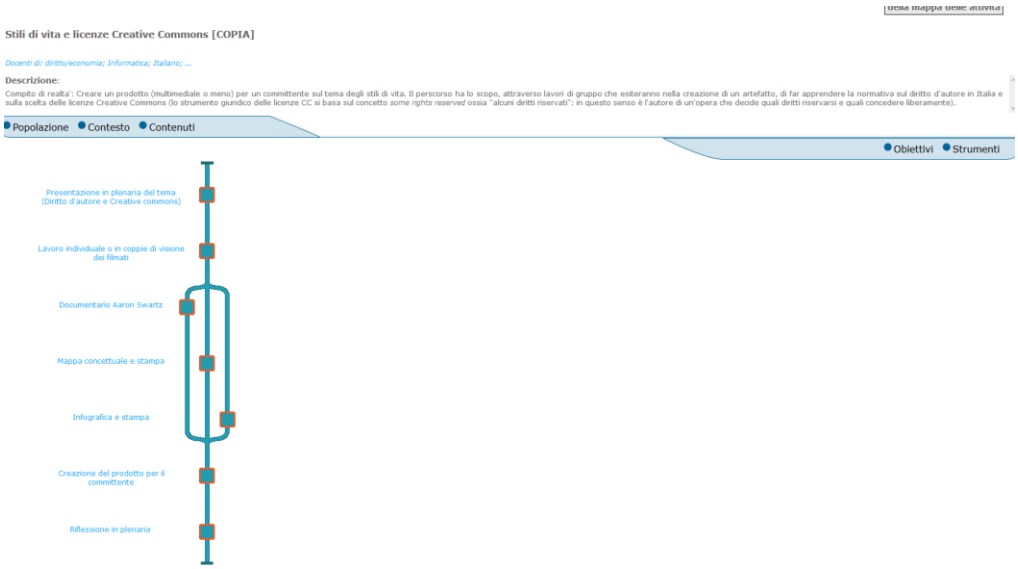
Title: Lifestyles and Creative Common licences

Authors: T1 and T14

The section of the PP guiding the Conceptualization process was filled in but was incomplete. Teachers described context and population but did not detail contents (throughout the Mind Map tool), educational objectives of the unit of learning (including knowledge, abilities and competences) and tools and resources to be adopted.

As to the Authoring phase teachers created the flow of activities but kept the description of the single activities at a shallow level (general idea), without detailing the objectives, organization of the work, etc.

The design includes five activities (the 3rd was declined in three different alternatives as parallel paths to be followed by different groups of students)



Hereunder an overview of the sections of the PP filled in.

Conceptualization	**Filled in**
Population	Yes
Context	Yes
Contents	Missing
Objectives	Missing
Tools and resources	Missing
Authoring	
Flow of the activity(ies)	Yes
Description of the single activity (ies)	General idea only

Design B
Title: Food labels
Authors: T2 and T3

The Conceptualization section was filled in item by item. Teachers described context, population, contents (with the help of the mind mapping tools embedded in the PP) educational objectives of the unit of learning (including knowledge, abilities and competences) and tools and resources to be adopted. The Mind Mup function was adopted to describe the contents to be delivered.

As to the Authoring phase teachers created the flow of activities but kept the description of the single activity at a shallow level (general idea), without detailing the objectives, organization of the work, etc.

The flow was composed of 3 activities. The 2nd activity was divided in two parts. Part A entails the presentation of a typical food label by means of a lecture, part B entails a work group having the aim of preparing a food label in English.

Hereunder an overview of the sections of the PP filled in.

Conceptualization	**Filled in**
Population	Yes
Context	Yes
Contents	Yes
Objectives	Yes
Tools and resources	Yes
Authoring	
Flow of the activity(ies)	Yes
Description of the single activity(ies)	General idea only

Analysis of the designs (Jamboard)

Title: 'It's better healthy space'
Author: T2
Subject: Nutrition

The design describes the steps of one single activity about chemical leavening. The context was described only as to the class (1 pan post it) that means students of the 1st year for bakers will be involved.

The description of the activity is scanty, based on two figures and post-it. The activity is a practical experiment: figures show the products used for the experiment and the chemical model for the evaluation.

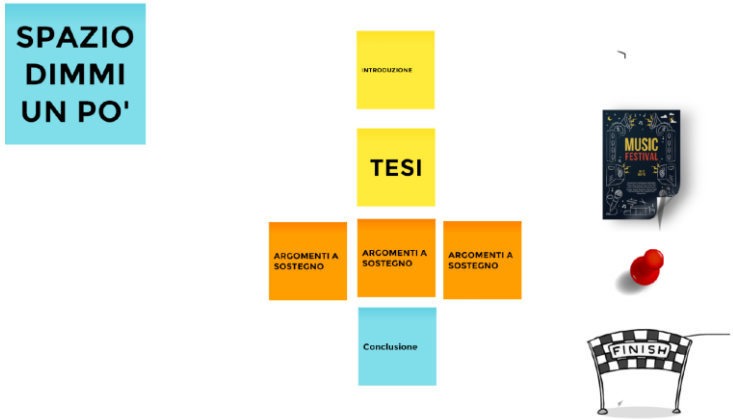
Title: 'Easy space'
Author: T3
Subject: English

The design is simple and not explicit. It includes the elements to carry out an activity that is not explicitly described. The context was described only as to the class (5 anno post it) that means that is for students of the fifth year.

Title: ‘More or less space’
Author: T4
Subject: math

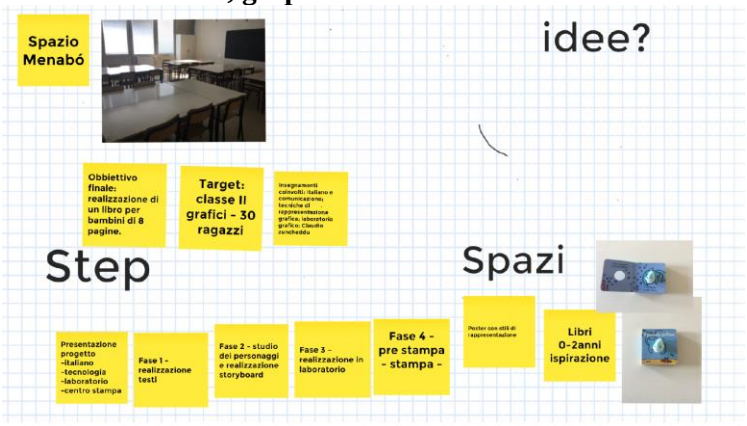
The design is simple but includes a description of the context (class and population) and of the contents. Some resources for the activity are reported. On the other hand, the steps of the activity are not explicit.

Title: ‘Tell me space’
Author: T5
Subject: Language and communication



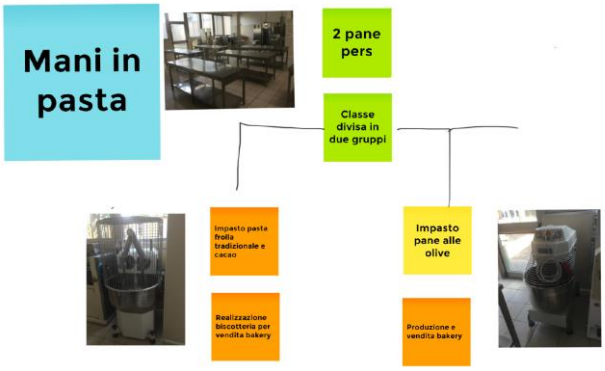
The design is simple and does not address a specific context. It summarises the sequence for discussing a thesis.

Title: 'Mock-up space'
Author: T1 and T15
Subject: Communication, graphics



The description of the design is rich. It includes the description of the context, population, objectives (the creation of a book for children) and the set-up of the space. The sequence of activities is clearly described. This design could be shared and reused.

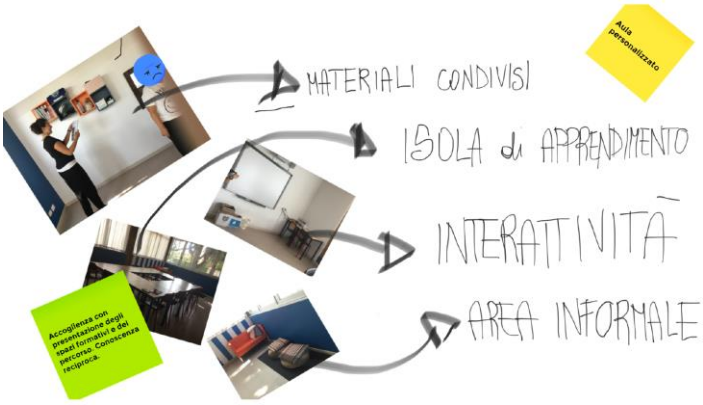
Title: 'Hands in dough'
Author: T12
Subject: Bakery lab



The design is simple and related to a single activity (preparing two different kinds of dough). It describes the context (in the pictures) and the population ('2

pane pers' post-it) that means bakers, second year students with disabilities. It only cites the two activities in post it and their aims.

Title: 'Personalized space'
Author: T13
Subject: Welcome for disabled students

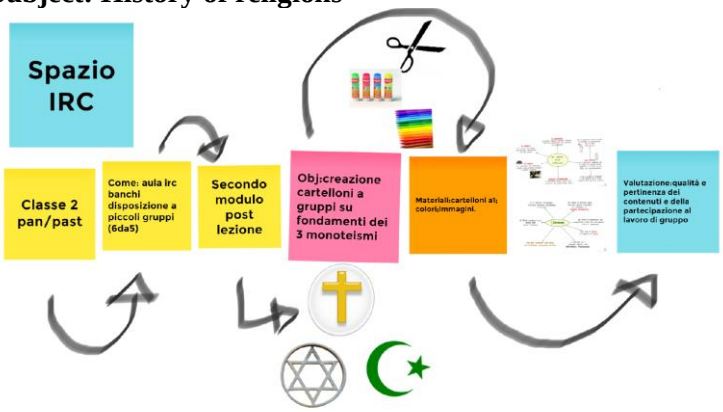


The activity is aimed at welcoming the newly arrived disabled students and familiarize them with the school spaces. It is just a collection of the spaces that should be presented.

Title: 'It was time space'
Author: T14
Subject: Geography and economy

The design tackles a topic of self-determination of people. The design is not targeted to a specific population. It includes info about the kind of activity (that is not described in detail), but it is mainly focused on resources delivery (resources are embedded in the design).

Title: 'IRC space'
Author: T16
Subject: History of religions



The design is about the 3 foundations of monotheistic religions.

The design includes info about population, objectives, resources, materials and evaluation. The steps of the activity are not described.

Q4 - End of the training questionnaire

Section A: Changes in the design practice

1. In general, would you say the training brought any change in your design practice?

□Yes **(5 respondents)** □No □ No answer **(2 respondents)**

Please briefly motivate your answer

T4: "It improved the setup of the learning design".

T2: "I tried to apply the knowledge acquired during the course".

T1: "It provided me with a scientific base on the teaching practice that I felt only experiential and poorly reasoned at an academic level. I am aware that I still do not use and master most of the training tools / approaches / indications, but I am aware of them".

T5: "It helped in creating an order that was absent before".

T15: "Greater attention to design"

One of the two teachers who did not answer, commented:

T13: "*Since I haven't participated in the whole course, I can't say to what extent it changed my design practice… I usually consider some suggested aspects, others represented a starting point".*

2. During the training a design approach was proposed through the PP. Have you adopted this approach or some aspects of the approach (e.g. the description of the elements - context, population, etc. - that influence the design, the lesson sequencing, etc.) even without using the tool

□Yes **(1 respondent)** □No **(5 respondents)** □ No answer **(1 respondent)**

3. If so, please select in the list below how the approach influenced your design practice by ticking the box of the item(s) in the list and indicate how frequently you do this. Please feel free to add any other innovation you brought into your LD practice as a consequence of the training.

Tick	Design action	How frequently[1]
T15	I design the teaching/learning activities more systematically	
T15	I draft the design on paper	
	I describe the context for which the learning path is designed	
	I describe the population for which the learning path is designed	
	I describe the contents to be addressed in a content map	
	I describe the learning objectives of the learning path	
	I describe the tool/resources to be adopted in the path	
	I represent graphically the sequence of activities in the learning path	
	I describe in text format the sequence of activities in the learning path	
	I describe the single activities in the learning path	
	I revise the design after having carried it out	
	I share my designs with colleagues	
	Other (specify).....	

[1]How frequently: please indicate if 'sometimes', 'often', 'always'

4. If not, please specify why:

T4: "The approach is demanding in terms of time, we cannot afford it".

T2: "I conceive what I have to do in relation to the objectives to achieve, but I don't make a pedagogical planner-like description".

T1: "I did not acquire the tool in my practice. To be honest, due to my practice, the laboratory nature of my subject and the different sides in which I am engaged, I find it very difficult to dedicate. time to such a detailed planning of my training intervention".

T5: "*Time issues".*

5. Do you envisage any advantage in keeping using the PP tool for designing teaching and learning activities?

□ Yes (2 respondents) □ No (3 respondents) □ I don't know (1 respondent)

T2: "I find it difficult to be applied. Compiling it is demanding". **(no advantages)**

T1: "It would help me formalizing my intervention". **(advantages)**

T5: "It would allow to better personalize lessons". **(advantages)**

6. According to feedback collected in surveys and interviews carried out before, the adoption of the tool was limited. Please indicate what of the following aspects represented a BARRIER to the adoption of the tool (PP) (3 alternatives as a maximum, the most significant ones in your opinion).

Barrier	Description of the barrier	Tick
Lack of institutional support	My institution did not give me enough support to adopt the tool	
Lack of adequate training	The training on the PP wasn't adequate	
Scarce adoption by colleagues	The tool wasn't widely adopted by colleagues	**1**
Conceptual complexity of the tool	The tool is too complex	**2**
Scarce use of ICTs in the teaching practice	My use of ICTs in the teaching practice is scarce	**1**
Time/workload aspects	I can't use it since I do not have enough time (i.e. due to my workload)	**5**
Lack of motivation	I'm not motivated enough to use it in my practice	**2**
Scarce adherence to my needs/practice	The tool does not satisfy my needs/it's not coherent with my practice	**2**
Scarce adaptability of the tools to the context/curriculum	The tool is not flexible enough to be adapted to my context or curriculum	
Lack of confidence with technology	I'm not confident enough with technologies	**1**
Lack of creativity	I'm not creative enough to use it	**1**
Negative attitudes of students towards TEL approaches	Students may have a negative attitude when the design prepared with the PP implies the adoption of technologies in the classroom	
Lack of support to orchestration (including maintenance and help desk of deployed designs)	I do not get enough support regarding maintenance and help desk, when I set and manage the learning designs that I have deployed in the class	
Other (specify)……..		

Section B: Jamboard

Last spring you participated in a meeting devoted to reflecting on the teacher training experience after which you identified Jamboard (by Google) as a suitable tool for designing teaching and learning activities.

1. Did you use Jamboard after the meeting?

Never	Sometimes	Often	Always
6	**1**		

2. For which purposes did you use it? Please indicate for which of the purposes in the list you used it by ticking the box of the item in the list and indicate how frequently you do this

Tick	Design action	How frequently[1]
	Designing the teaching/learning activities more systematically	
	Describing the context for which the learning path is designed	
	Describing the population for which the learning path is designed	
	Describing the contents to be addressed in a content map	
	Describing the objectives of the learning path	
	Describing the tool/resources to be adopted in the learning path	
	Describing the sequence of activities in the learning path	
	Describing the single activities in the learning path	
	Drawing/representing the sequence of activities in the learning path	
T4	Revising my designs after having carried it out	
	Sharing information with colleagues	
	Other (specify).....	

Afterwards, you got a design task by the trainer to be carried out by using Jamboard.

3.Did you carry out the task?

□Yes **(5 respondents)** □No **(2 respondents)**

If so, in the following questions (4 and 5), we ask you to rate the tool in relation to its ease of use and usefulness

4.Please rate from "Not at all" (1) to "Very much" (5) the following statements about Jamboard.

	Ease of use	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	**2**	**3**	**4**	**5**		
1	The tool is easy to be used	0	1	2	2	0	3.2	.84
2	The tool is engaging	0	4	1	0	0	2.2	.45
3	The tool is flexible	0	2	2	1	0	2.8	.84
4	The tool makes the design process easier	2	2	1	0	0	1.8	.84
5	The tool allows to save time	3	1	1	0	0	1.6	.89

	Usefulness	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	2	3	4	5		
1	The tool is useful	2	1	2	0	0	2	1
2	The tool supports the conceptualization of new (collaborative) activities	2	2	1	0	0	1.8	.84
3	The tool allows to effectively represent the learning path	2	2	0	1	0	2	1.22
4	The tool helps considering the elements at play (context, population)	2	2	0	1	0	2	1.22
5	The possibility to describe (in text format) the different elements is useful	2	1	1	1	0	2.2	1.3
6	The possibility to graphically represent the design is useful	1	3	1	0	0	2	.71
	The possibility to import files is useful	1	2	0	2	0	2.6	1.34

7								
8	The tool supports self-reflection	2	2	0	1	0	2	1.22
9	The tool promotes discussion and sharing among colleagues	1	1	1	1	0	2.5	1.29
10	The tool supports reuse and adaptation	1	3	0	0	0	1.75	.50
11	The tool is coherent with the teacher design thinking	1	3	0	1	0	2.2	1.10

	Sustainability	**Not at all**				**Very much**	**Mean**	**St.dev**
		1	**2**	**3**	**4**	**5**		
1	I think that in the future I will use Jamboard for designing teaching/ learning activities	2	3	0	0	0	1.6	.55
2	I think that the Pedagogical Planner could be used by my colleagues in the future for designing teaching activities	1	2	1	1	0	2.4	1.14

5. Point out two positive and two negative aspects of Jamboard as design tool

Positive

T1: ***"It is integrated in GSuite that we already use"; "Online collaboration in real time".***
T4: ***"It eases communication"; "Graphics".***
T13: ***"Make the whole path more visible"; "Greater design sharing with colleagues".***
T15: ***"Collaborative"; "Intuitive".***

Negative

T1: ***"The tool is not designed for this purpose: it has not a structure that suggest the steps to be taken"; "It would be convenient with the Jamboard (Google whiteboard)".***
T4: ***"Padlet has more functionalities".***
T13: ***"For the kind of design required by the Institution for my subject can be hardly usable"; "It requires a use of technologies that I usually don't do".***
T15: ***"Messy"; "Limiting, due the absence of superstructure".***