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How to support teachers in becoming teachers as designers of student-centred approaches

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Abstract

This article presents a design-based research (DBR) methodology to develop a teacher professional development intervention that is aimed at helping teachers become designers of student-centred e-learning activities. The intervention was tested at Gulu University (GU) and Maseno University (MU), and a set of activities and tools, as well as six design principles, were recommended for future interventions. The findings suggest that becoming a designer requires teachers to transform their understanding of their practices and to develop teachers as designers (TasD) mindsets. Further research is needed to conceptualise these mindsets and to map and compare the epistemological traditions of learning, design and teaching practices.

Keywords

Teachers as designers, learning design, design for learning, design process, designerly ways of thinking, student-centred learning.

Introduction

At different levels, teachers are increasingly tasked with designing contexts, frameworks, tools, technologies, learning environments (i.e. physical and digital) and learning activities to prepare their students for a constantly changing world. Teachers must cope with twenty-first century learning and teaching dynamics, which demands a paradigm shift from teacher- and curriculum-centred approaches to learner-centred and problem-oriented approaches. The integration of new technologies demands that teachers not only prepare students for meeting the demands of Industry 4.0 regarding competences and knowledge but also incorporate these emerging technologies into their teaching practices to support and foster learning, which requires changing their pedagogical and teaching methods (Miranda et al., 2021).

To address these new educational challenges, teachers need to develop new competences and ways of acting. A promising approach is the incorporation of design in the educational field – particularly emphasising teaching as a design profession (Laurillard, 2012; Warr & Mishra, 2021), with a specific request for teachers to become designers. When there is considerable research scaffolding teachers in their designer roles, for example, focusing on methodologies (Conole, 2014; Conole & Weller, 2008), tools (Yeoman & Carvalho, 2019), design process (Camacho et al., 2018; Young & Perovic, 2018) and patterns (Goodyear, 2005) to guide/support teachers to create designs, we know that some teachers do not perceive themselves as designers and face challenges in applying design principles to their practice (Camacho et al., 2018). To explore and empower teachers to approach educational problems as design challenges, more research is needed. This research should not only focus on providing teachers with methodologies, tools and processes for applying design in their teaching practice but also help shape their role as designers and provide tools to aid in this process.

In this theory-based and empirically tested work, we seek to contribute to design interventions to support teachers in becoming teachers as designers (TasD). We explore two questions: What is required for teachers in higher education to view themselves as designers? How can professional development activities prepare teachers to become TasD? The empirical work in this study was conducted in two universities in the East African region.

This article is structured into six sections. First, we explore how the literature outlines design and education to better develop and conceptualise TasD and review key academic work on TasD. Second, we present our research methodology: design-based research (DBR). Third, we illustrate the design of the intervention (prototype). Fourth, we share the experience of conducting the intervention at Gulu University (GU) in Uganda and Maseno University (MU) in Kenya. Fifth, we propose design principles for future interventions to support university teachers in becoming TasD, followed by the conclusion.

Teachers as designers (TasD)

Research on teaching and design is broad and covers several disciplinary fields. One of the most comprehensive studies that discusses the different schools of teaching and design is the work of Warr and Mishra (2021). By conducting a literature review, the authors identified ten strands of scholarships that describe TasD and how these strands are conceptually related. The authors employ the term 'strand' to characterise clusters of research that are thematically linked and utilise teaching and design constructs in a comparable manner. Even if Warr and Mishra limited their analysis only to publications with the K12 sector, we find their work relevant to contextualising our understanding of TasD within higher education.

Warr and Mishra identify strands such as *learning design* (Conole, 2013; Goodyear & Dimitriadis, 2013; Laurillard, 2012), where the focus is creating artefacts to scaffold the design process of curriculum learning activities, helping teachers make informed decisions for their designs and making them sharable; *learning by design* (Kolodner et al., 2003), which is considered a design pedagogy (a way of learning); *design thinking* (Meinel & Krohn, 2022), which in recent years has become very popular in the educational context and has been utilised not only as a pedagogy to teach but also as a design epistemology that provides arguments regarding how designers think. Further, we also find *design based research*, *collaborative curriculum design* and *participatory research*. These three strands focus on the collective effort of teachers, researchers and other stakeholders to develop artefacts, learning activities or curriculums. The different strands are connected by the suggestion that design is a key activity of teachers and that teaching can be considered a design profession, with the difference being the approaches of the different researchers for who is doing the design, the role of the teachers, how to support the design process, why framing TasD and the understanding of design (Warr & Mishra, 2021).

This article focusses on the strand of TasD. The specific term of TasD has been more often cited in the field of technology-enhanced learning (TEL) (Kali et al., 2015; Mishra & Koehler, 2006). However, the term has recently expanded to other areas of teaching practices (Henriksen et al., 2020; Kirschner, 2015). In the context of this paper, TasD are practitioners in higher education who, because of their teaching practice, constantly face different type of challenges. University teachers have in general been educated not as teachers but as research practitioners within their fields. Furthermore, TasD are different from professional learning designers; the latter are

professionals who assist teachers with applying technology or innovative pedagogies to improve their teaching practice or professionals who design for learning but do not teach (Altena et al., 2019). We do not refer to teachers who help professional designers to design.

In this study, we widen the field of what is designed for beyond TEL. We acknowledge and agree that technology has changed teaching and learning practices, necessitating a design perspective to address this complex and ill-structured challenge. However, teachers need to be designers to address other challenges, such as a) designing a curriculum that fits current and future societal needs, b) generating new learning activities to develop twenty-first-century needs, c) adapting and redesigning innovative pedagogies, d) finding ways to motivate students to stay in school, e) finding ways to communicate and collaborate with various stakeholders, f) devising different approaches to promote students' and teachers' well-being and g) finding ways to becoming learning organisations.

We are aligned with the perspective of Kirschner (2015), who states that TasD must excel in at least three distinct fields. First, TasD must possess deep knowledge about the subjects they teach. Second, they should be well-versed in the art and science of teaching and learning, encompassing an understanding of diverse pedagogical approaches to effectively achieve educational goals. Last, teachers need to grasp the science of design.

This last aspect is the add-on for TasD, because in their role of designers, teachers should be aware of and knowledgeable in the design field: the process, mind-sets, tools and materials. Therefore, TasD are teachers who aim to improve a current situation into a preferred situation by applying rational decision-making (Simon, 1969). TasD are aware that design requires a creative approach to solving problems and demands great competence regarding reflection 'in' and 'on' action (Schon, 1983). They also use designerly ways of thinking (such as creativity, curiosity, openness to different perspectives, collaborative work approaches and willingness to embrace ambiguity) and knowing when to face and approach ill problems (Cross, 2011). TasD convert educational challenges into design challenges and based on the collection of data on students, stakeholders and the context, generate solutions in collaboration with students, colleagues and other stakeholders.

Related work of supporting teachers in becoming designers

There is no doubt that teachers engage in design (Garreta-Domingo et al., 2018); however, many teachers do not identify themselves as designers (Henriksen et al., 2020) or are unfamiliar with the practice of design (Bennett et al., 2018). Actually, the design practice for many teachers is tacit; they do not use explicit design knowledge to design their courses and frequently base their design practice on previous experiences (Conole, 2013). Recently, there have been substantial efforts in testing and development of different proposals to support teachers in incorporating design knowledge in their teaching practices.

Some of these proposals are actionable knowledge about design in the form of specific steps that teachers should follow. For example, ABC Learning Design (Young & Perovic, 2018) is a method for systemic and collaborative design and redesign of learning experiences in higher education. This method guides educators to identify the specific learning goals and learning activities in which students should engage during a course module. Other examples are the 7Cs of Learning Design proposed by Conole (2014) and the learning design conceptual framework (Dalziel et al., 2016).

Another proposal that is highly related to the previous proposal is to scaffold the design process through materials, where these materials support the dialogical process, sharing of ideas and making implicit assumptions explicit. These approaches heavily rely on visual thinking. Examples of these approaches are the work of (Yeoman & Carvalho, 2019), who designed a set of cards to facilitate application of the Activity-Centred Analysis and Design method and the D-Thinking Toolkit to apply design thinking in education developed by Tschimmel et al. (2017).

We also find proposals that involve teachers in concrete design processes using specific design methodologies. Research indicates that teachers change their views and meaning of teaching as a design science if they experience a real design process (delimitate the problem, gather and analyse data, co-create with others and use design tools such as brainstorming, diagrams, and visual thinking) using their own practice problems. In other words, rather than offering procedural design approaches, design should be learnt by engaging in design (Gachago et al., 2017). Within this approach, there is the work of Henriksen et al. 2020, who explore how the design thinking framework (Stanford Design Thinking Model) can serve as a framework for teachers to engage and solve real problems in education. Other examples of these kinds of approaches are the work of Boloudakis et al. (2018) and that of Brown et al. (2020). Recent approaches, albeit few, focus on changing the values of teachers (Chai & Koh, 2017) and design mind-sets (Baran & AlZoubi, 2023; Noh & Karim, 2021).

Despite a strong research focus on learning design within educational research in the last decade, further research is needed. To facilitate the process of teachers becoming TasD, we are especially interested in the addition of three elements to the current research. First, we begin by emphasising the importance of explicitly addressing design knowledge. We firmly believe that if we consider teaching as a design profession, then we must treat design knowledge with the seriousness that it deserves. The following questions should receive dedicated and explicit attention when supporting teachers to become TasD: What is design? What truly happens during the design process? How can we approach problems with a designer's ways of thinking? How can we perceive learners through the lens of design?

Second, it is crucial to address design ways of thinking. As mentioned above, many teachers do not consider themselves designers. They have simply not viewed their profession from that perspective, and/or they do not know how designers think and work. To address this issue, an open discussion about their assumptions and beliefs about teaching and design may be fruitful to change their way of thinking.

Last, to carefully design learning spaces to foster the transformation to TasD, our assumption is that physical, online and hybrid spaces must be re-designed to facilitate a designerly way of working (co-creation, visualisation, iteration, flexibility and partnerships).

Research methodology

Our work is anchored within the context of the Digital Learning Innovation (DLI) project, which is aimed at developing a methodology to implement student-centred e-learning in universities in the East African region (Camacho & Dirckinck-Holmfeld, 2020) The DLI project followed the DBR methodology: 1) understanding and analysis of the practical problem with researchers and practitioners, 2) development of a solution (prototype) informed by theoretical inputs, 3)

iterative process of testing and redefining the solution and 4) reflection to produce design principles (Reeves, 2006).

Based on steps 1 and 2 of the DBR methodology, the team formulated the first prototype of the student-centred, e-learning implementation methodology, which is composed of five phases: envisioning, preparing, piloting, scaling up and maturing (Figure 1). The description of the methodology and the tools can be accessed at https://shorturl.at/fxTYZ

Figure 1: Student-Centred e-Learning Implementation Methodology

The methodology proposes specific tools for implementing each phase; therefore, a micro-DBR process was conducted to develop each of the tools proposed for each phase.

In this work we present only the micro-DBR process to develop the Learning Designer Workshop (LDW), which is the first tool in the preparing phase (figure 1). Note that the project did not initially have the concept of TasD, so working with TasD evolved through the DBR process.

To generate the first LDW prototype, the project group ran some design workshops and reviewed the literature to inform it (Altena et al., 2019; Bower & Vlachopoulos, 2018; Camacho et al., 2018; Conole & Weller, 2008; Conole & Wills, 2013; Dalziel et al., 2016; Frick et al., 2013; Gauntlett, 2014; Groeger & Schweitzer, 2020; Henriksen et al., 2017; Kohls, 2019; Laurillard, 2012; Lorenzetti et al., 2016; Tracey & Hutchinson, 2016; Tsoukas, 2009; Young & Perovic, 2018). The first prototype of the LDW considered the following theoretical guidelines: 1) it should support teachers to become familiar with an explicit design process that generates a shareable design; 2) teachers would make conscious and explicit pedagogical choices; 3) the learning space should support productive dialogues, knowledge co-creation, visual thinking, collaboration, creativity and play learning; 4) teachers should be provided new tools from the design thinking field; and 5) teachers should be supported to reflect on their role as designers, with the aim of reshaping their professional identity.

The LDW is aimed at guiding academic staff in designing meaningful student-centred learning experiences for an e-learning or blended learning environment. The workshop lasts 30 hours over the course of four or five days, including an online microlearning course to share content about TasD, design for learning and user-centred design.

The first pilot was conducted at Gulu University (GU) during Aug-Sep 2021. The LDW had 20 participants drawn from the faculties of Business and Development Studies, Education and Humanities, and Science and staff from the Library and directorate of technologies services. Participant composition included nine females and 11 males. Most of the participants were young lecturers with master's degrees, with only two having attained a PhD. However, the teaching experience ranged from four to 20 years at a university. The group was divided into two macro groups, which were further subdivided into two subgroups. The two macro groups engaged in different activities.

The second pilot was conducted at Maseno University (MU) during Oct–Nov 2021. The MU pilot study comprised 12 participants from the Faculty of Education, with a learning designer from the e-Campus. The participants comprise five males and eight females. Two participants had teaching experience ranging from seven to 10 years, while the remaining faculty members had accumulated 15 or more years of teaching experience. Importantly, all participants held a PhD degree. The learning designer also functioned as a local facilitator. The group was divided into two subgroups, were engaged in the same activities.

Data were collected in each of the different activities that were implemented at GU and MU (see Table 1). Furthermore, the project team had design and reflection sessions to obtain the final prototype presented in the following section.

Table 1: Activities and data collected at GU

Activity	Data and format
Microlearning online course	Exercises completed by the participants
LDW (on-site): Macro group 1: ITC staff and library staff members from computer science were introduced to tools to understand students/users (day 1). They collected data through interviews and observations about their users (days 2 and 3) and completed Personas and Learner Empathy map templates with the collected data (day 4). There was a reflection session at the end of the LDW. Macro group 2: Staff members from the other faculties completed the exercises presented in figure 2 (three full days), with the exception of empathy with students. Instead, they had a short future workshop with students. There was a reflection session at the end of the LDW.	Videos with the presentation, material produced by the teachers and audios from the reflection session
Working session to analyse the results of the workshops to continue development of the prototype. This two-hour session was conducted only with the project leaders and local leaders.	Word document with the minutes for the sessions and audios.

The pilot at MU was organised in a manner similar to the pilot at GU, with the exception that they only engaged in the activities of macro group 2. Another difference between the two pilots was that the activities in MU were performed in a hybrid modality, meaning that the teachers and a local facilitator were in the same physical room at MU and the facilitators from Denmark participated by Zoom. The data were analysed to obtain inputs, and the prototype was relevant to help teachers become TasD and to improve the prototype of the LDW.

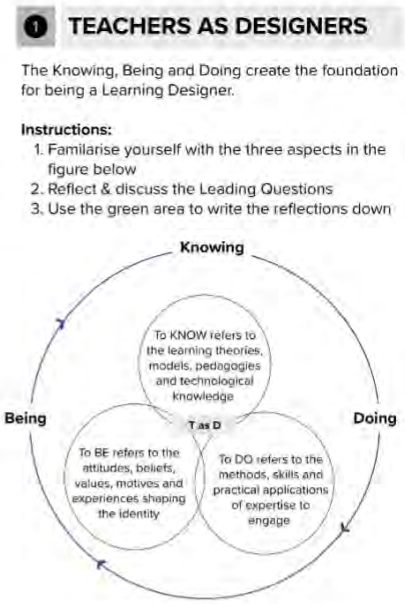
Prototype of the Learning Designer Workshop (LDW)

The prototype of the LDW is presented visually in Figure 2 (see following pages). The figure represents the improved prototype after the MU pilot. The prototype distinguishes two main activities: introduction to TasD and a process to design courses within the framework of SC-e-learning. The introduction of TasD includes three activities (1–3 in Figure 2), and the design process is composed of five activities (4–8 in Figure 2). Each activity is facilitated through a canvas (the canvases can be downloaded as PDFs here: https://shorturl.at/sHSV4), which was carefully designed to produce a concrete outcome, and materials such as markers, Post-it notes, Legos, flip paper, stickers and a deck of cards. Activities 1–7 should take place in a design thinking environment to facilitate the physical, social and psychological dimensions of the design process.

1) TasD Concept

The activity guides the teachers to get to know the theoretical concept of teachers as designers and some examples. Some questions are provided to help the group to reflect, share, and discuss their interpretation of the concept in their everyday practice.

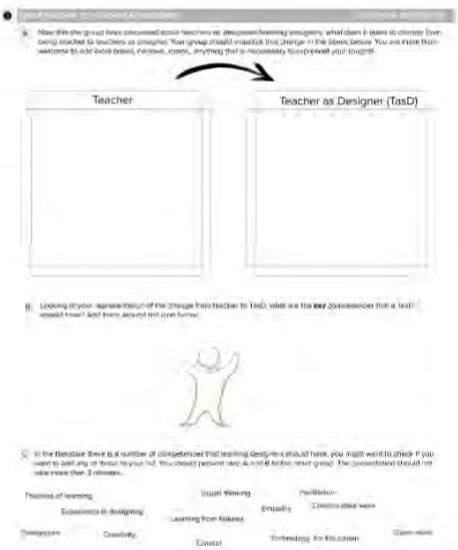
The activity acts as a warming-up exercise and an opportunity to identify point of views, different understandings and relation of the concept with the teaching practice. Post-its are used for individual thinking before moving to group discussions.



2) From teacher to TasD

In this activity, teachers go through a process of sense making, co-creation and reflection. First, teachers are asked to draw what it takes to change from being a teacher to becoming a TasD. Afterwards, they are asked to extract concrete attributes of a TasD and draw them or represent them with 3D materials, such as Legos.

Finally, they are presented with some cards with attributes of designers, and they are asked to discuss whatever the attribute is already in their drawing and if it should be there. Furthermore, they are asked to self-assess if they have those attributes.



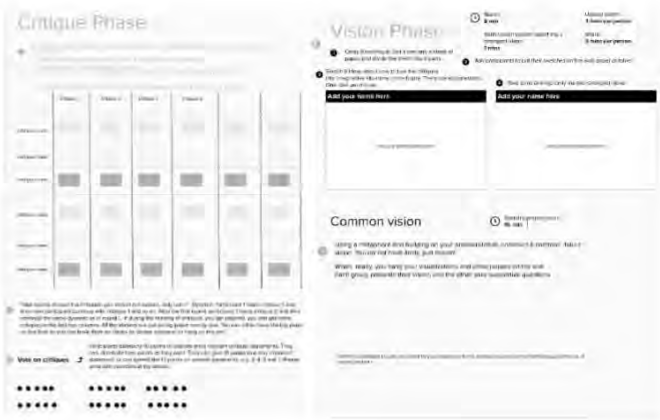
3) Learning values and pedagogies

In this activity teachers make their learning and teaching assumptions and values explicit. They answer 3 questions: how do people learn? What is meaningful learning and What do students need to develop their full academic and social potential?

After sharing their answer, they work with an affinity diagram to promote dialogue. Then, they are asked to brainstorm about which pedagogies could support those values. The group gets 10 cards with innovative pedagogies and they are guided to discuss how those pedagogies can materialise their learning and teaching values.

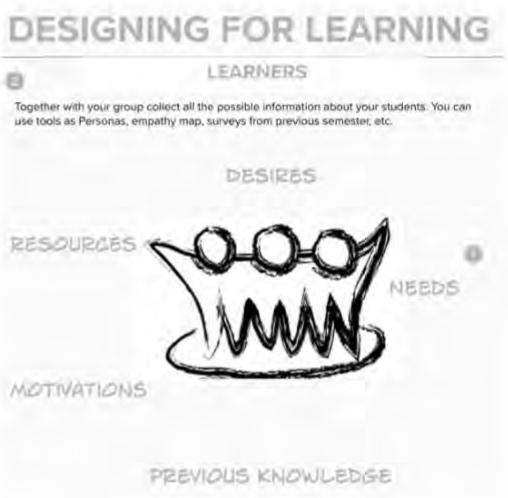
4) Future Workshop: what are our challenges?

This activity helps the group to identify educational challenges. The Future workshop (FW) is composed of three steps: critique phase, vision phase and realization phase. The group skips the last step. The FW starts with a question related to the challenge at hands and then finishes with an ideal scenario. The result of this activity is the course or problem that the teacher will work with during the design process.



5) Empathy: understanding our students

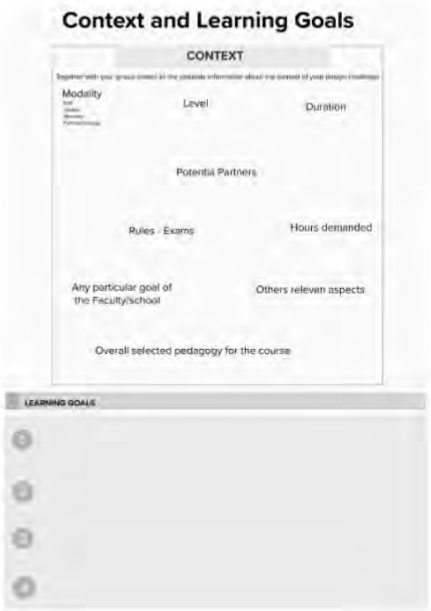
In this activity, teachers learn tools to get to know their students better: Learner Personas, Learner Empathy Map, and Learning Experience Map. Participants gather data by interviews or/and observation.



6) Define: context and learning goals

Teachers visually represent all the organizational aspects that will impact the design of the course, such as exams rules, durations, location of the course in the curriculum, possible external collaborators and overall pedagogy for the course, among other aspects.

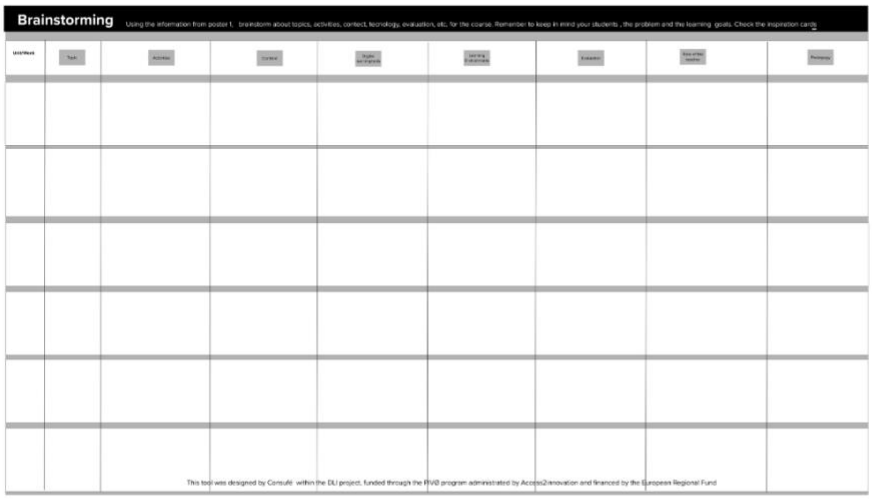
The activity finishes with the definition of the learning goals.



7) Ideate: Collective knowledge

Participants are guided to gather ideas for the relevant aspects for the course design: topics to cover, learning activities, content, learning environment, digital technologies, role of the teachers and students, assessment. They are encouraged to individually brainstorm to generate ideas for the different aspects and then create a kind of student learning journey together.

Teachers are supported with a deck of inspirational cards about technologies, SC learning activities and assessment activities. They conclude with a course blueprint in a Word format.



8) Create: from prototype to digital platforms

In this activity is ore production where the course is implemented on the institutional Learning management system, including the production of material and learning activities.

Figure 2: Prototype of the Learning Designer Workshop

Experience of teachers working with the prototype

In this section we present the third step of the DBR methodology: the iterative process of testing and redefining the prototype of the LDW. We observed from the data that different elements interwind to create an experience that was significant and meaningful for the participants; however, we attempted to reflect separately on three main aspects – materials, the process and outcomes, which allowed us to improve the prototype and generate more elaborate design principles for supporting teachers to become designers. Before reading the next sections, we recommend having a look at figure 3 to get a glimpse of how the teachers worked in GU and MU.

Material suitability – Tools and space

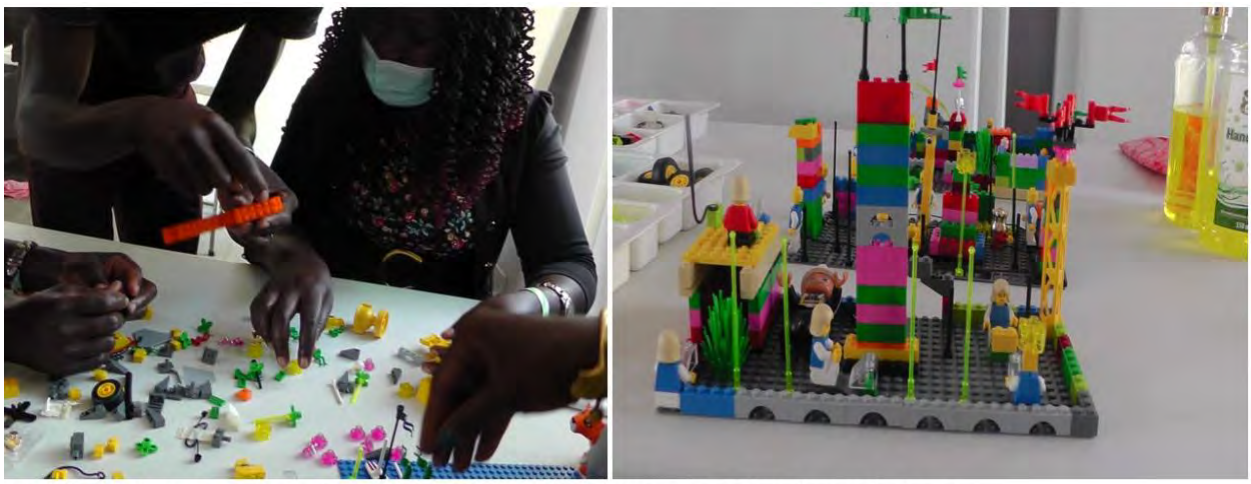
Regarding materials, we refer to the canvases (tools) used in the different activities (1–7 in Figure 2), the materials to work with the canvases and the learning space where the activities took place. The canvases are not just a visual representation in digital or paper format; they represent the embedded actions that the participants were guided to do.

The canvases and the specific materials to work on them promote new ways of interacting, reflecting, thinking (individually and collectively), co-creating, making decisions and learning. As one person from MU stated:

> *The tools were good because they allowed us to give honest opinions. The tools made us to do some critical thinking. The tools enable us to come up with our real challenges. At one point we were looking at is it really competency? So then we need capacity building. Is it infrastructure? Is it our attitude? The tools unconsciously enable you to respond in an honest manner. (V-MU-RS-F)*

The Future Workshop (FW, canvas 4) supports a problem-solving mindset, which is a key element in design thinking. The tool scaffolded the groups to collectively identify the key issues that they were facing and to define and select the significant issues to work on. The FW provided a framework to collect inputs from each group member and form a common understanding, moving from individual opinions and experiences to collective reflections and decisions. The tool was totally new for the group in MU, and as one participant (teacher) indicated, it 'throws them out of balance' but in a positive way because it broke their traditional way of thinking and idea of participating roles. The FW provided a dialogical space where all voices contributed – producing two metaphors for the significant problems, as they wanted to focus on including their vision for the future. The developed problems were how to design for large classes based on SC approaches, such as problem based learning (PBL), and how to train teachers on learning design.

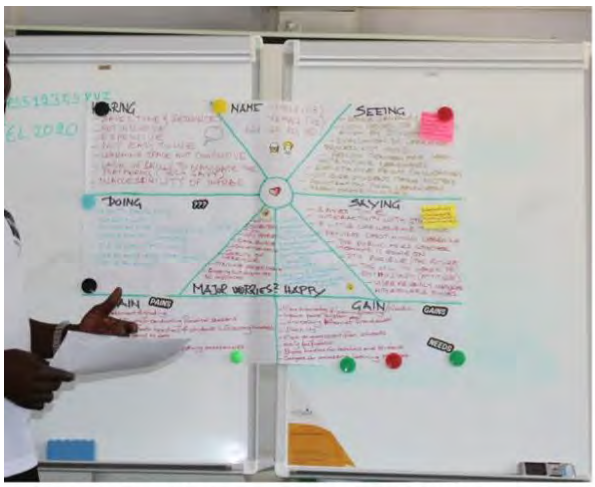
The tools adapted from the design thinking tools, such as learner personas and empathy maps (EMs), were meaningful, useful and revelatory for the participants. Those tools are concrete ways to understand students and empathise with the needs, desires, challenges, frustrations and strengths of the learners. These tools helped to create genuine SC learning and start the process of thinking about how to deal with the diversity of talents and needs in the classroom that need to be approached with different strategies.



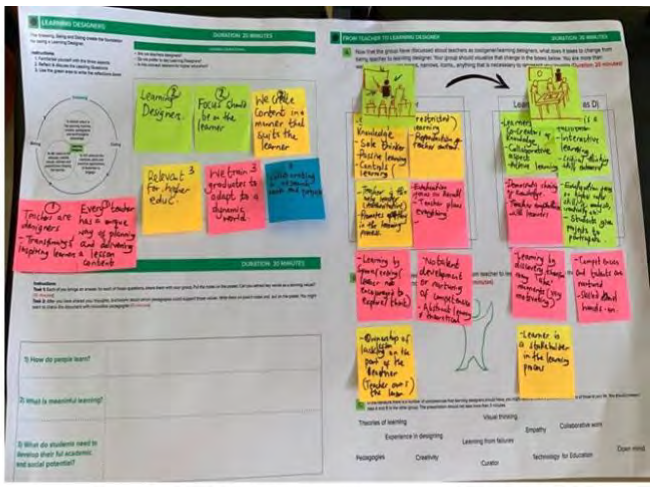
Work from Gulu University – working with Legos to construct their meaning of teachers as designers

View of the learning space in Gulu University

Work from Maseno University – Working with methaphorical thinking during a future workshop



Work from Gulu University – Learner Empathy Map



Work from Maseno University – Working with the step 1, 2 and 3 of Learning designer workshop

Figure 3: Glimpse of work carried out in GU and MU

Furthermore, collecting data from students with these tools and presenting visually enabled teachers to get insights into the students' behaviour. For example, when presenting the results of the EMs, one group indicated that the class dropout rate was high during the COVID-19 pandemic, highlighting that a lecturer could start a class with 100 students and finish with only

one-third (V-GU-EM-P). But the inputs from a group of students, showed that students mentioned that internet access was quite expensive and that sometimes they had access for only two hours (the duration of a lecture), but lectures sometimes did not start on time, meaning that they did not have enough internet access to finish the lecture (M-GU-FW). Such behaviour (starting lectures late) that was normal in face-to-face classes did not cause major problems for the students. In the new setting (online teaching), it became a problem, and teachers could see and understand it well from the EMs. The EMs also revealed the students' frustrations with the assessment and grading on the digital platform used by the university during the pandemic. The teachers wondered if these frustrations were derived from the students' lack of training in the use of the platform (V1-UCDW-EM).

The suitability of the tools is closely related to the use of materials provided to work with the tools and in the learning environment. The unusual approach of using tangible materials (Legos, prototyping materials, cards, markers, stickers, etc.) to design a course was perceived as a valuable way to support thinking, knowledge sharing and co-creation and had an impact on how to perceive and understand design. One person indicated:

> *We were able to collaborate and come up with one finished diagram that represents our thoughts and expresses our ideas, and it was quite critical because we had to reason, it had to make sense, be logical, you know, we discovered and expressed ourselves in all these forces without even thinking consciously about. (…) The visual aspect is very important; it relates to a lot of your senses, what you see, what you hear, how you react. The tools were more engaging by having the visual element. If we are talking about collaboration, dialogue and communication, it is a plus to have those kinds of visual tools. (V-MU-RS-F)*

Visual thinking tools were applied in all workshops, and gradually, a rich data, information and knowledge space was created. Each group created 'corners' with its canvas, which allowed constant validation, referencing and checking of information that enabled a continuous knowledge creation process. There were several instances of participants making statements such as 'Do you remember that Monday we were working with the FW and that we came up with this metaphor?' They were referring to materials hanging on the walls.

The movable small whiteboards were also a game-changing factor in the interaction of the groups, as they a) were used to materialising and systematising the ongoing discussion and b) could move the whiteboards easily to different working spaces within the room. This underlines that all tools affect the design process, denoting the importance of being intentional when equipping design-learning spaces. In general, the participants appropriated the space, which then facilitated the different stages of the design process. This setting was perceived as a valuable in a context that does not typically provide many opportunities for such types of interactions.

Regarding improvements to the prototype, canvas 7 needs to be redesigned, because even though it includes all the elements that a course designer needs to consider, it is difficult for the teachers to take all the elements at once. Furthermore, we can identify a missing tool: the technological tools to support the design process – that is, advanced technologies that can quickly and easily process and visualise data, such as AI, learning analytics, machine learning, and big data.

Relevance of the process

At the beginning, the teachers did not see themselves as designers. We observed a change as the teachers participated in the flow of the design process as a co-creation experience. They engaged in different discussions and reflections and slowly progressed in the production of tangible and valuable outcomes of designing an e-learning course within the frame of an SC approach. As such, the prototype was successful in promoting and encouraging reflection in and on action (Schon, 1983). Participants reported to have been challenged by the different activities to reflect and explicitly state their learning and teaching theories, problems and assumptions. The process motivated them to make the implicit explicit, and by doing so, they negotiated meaning, came to a mutual understanding and sometimes made adjustments or changes to their meanings or ways of thinking.

The participants highly appreciated working with their own real challenges and getting things done:

> *In these sessions we had WORKSHOPS, which means you are exposed and you implement, you do your work. [We] evaluate, scientifically, what the impact of what we have learnt to our learners is [and] the impact on our staff. Where are we now, and what is the impact of this? (V-MU-RS-F)*

> *Normally, when we do training, the learning goes with the trainers; for us, it remains here. You came at the right time. (V2-UCDW-EM)*

In the test at GU, we assembled teachers, ICT staff and library staff to work together, which was valuable for the three different groups. The groups were able to better understand each other's challenges, daily tasks and perspectives, being the most significant contribution of getting to work together to find solutions. The groups experienced the benefits of interdisciplinary collaborative work. One of the teachers reflected on the experience of working in a multidisciplinary group:

> *If you see this combination, the work from different entities there, [and] if we work in collaboration with the library, the ICT, and this department, we are able to improve on the quality of learning and teaching, and [as] stated from the start, it was student-centred learning. So, as the three teams can come together and see how we can design or improve on these platforms that we have (…), then certainly, this gentleman [referring to the person from the ICT department] is well blessed. Thank you for being around us, because we can voice out. (V2-UCDW-EM)*

Important feedback on the prototype is to find a balance between the process and the product. The design process was oriented towards producing a course designed with the SC-e-learning approach, which is innovative in several ways. However, this approach poses the risk of leading teachers back to the traditional way of thinking when asked to design a course. In our data we found examples of this challenge. During our GU pilot, we guided the teachers in selecting a course to be redesigned within the SC framework. However, we did not explicitly ask them to identify problems with the course itself. Here, we observed that teachers went back to the model of planning a 'content-based' course and did not focus on competences and student's needs and desires, even though they were aware of this approach. When brainstorming about learning activities, they could come mainly with the activities that they already had in the

course. We believe that we unintentionally moved the teachers to a zone where they knew very well what to do, and they started 'doing business as usual'. The intervention of the facilitators and the use of inspirational cards helped teachers move out of this 'zone'.

At MU, we modified the process based on what we had learnt from GU, but here also, the teachers were somewhat stuck in the course metaphor. Even though they came up with different real problems that they were facing and chose two problems as design challenges, we altered the problem-solving process because the canvas guided to a preestablished solution: 'a course'. We do not know if the solution to their problems could have been something different than a course. From the perspective of scaffolding to help teachers experience the design process, the fact that our steps lead to designing a course might have affected the freedom of teachers to explore and follow unexpected solutions.

We have modified our prototype, clarifying that teachers should identify problems for a specific teaching and learning activity (often a course) and then start the design process from there. However, as the aim is to support teachers to become designers, they should not be working to design a course in their first training but focus on identifying an educational challenge and finding a solution, going beyond the course metaphor. This finding is particularly important – as it demonstrates the need to be deliberate and explicit in the definition of the concepts used in the methodology, which should also be mirrored in the scaffolding materials (especially canvas 7, which needs to be redesigned).

Outcomes

The prototype achieved the goals of designing courses within the SC framework, as each of the groups finished with a course blueprint and adopted/adapted new SC activities and technologies. Furthermore, the groups implemented their blueprints in a learning management system. We can state that the prototype also achieved the aim of moving teachers closer to being designers, as they became aware of their design practice and started engaging in designerly ways of thinking.

Canvases 1 and 2 allowed teachers to engage in deep reflections and discussions about their roles as designers. At the beginning the participants did not consider themselves designers and instead saw themselves as professors/teachers. Even though they could recognise that they do design, they visualised a designer in the light of an artist, architect, fashion designer and the like. However, as they went deeper into their teaching practice, they realised that they also do design in this context.

When arguing to call teachers, designers, some of the groups concluded, 'Every teacher has a unique way of planning and delivering lesson content', 'we train graduates to adapt to a dynamic world' and 'we collaborate in research works and projects'. When differentiating teachers from those who act as designers, the main differences were that the latter 'empathise with the needs of the learners' and 'focus on formative learning', 'learning happens in two ways' (meaning that teachers also learn) and TasD 'are inspirational, creative, innovative and interact with the learner' (M-MU-C1&2).

We consider that promoting design-thinking mindsets might have a strong influence on the way teachers think and do things, which might help to enrich their practice. Design tools and the design process are important, but they materialise from a particular way of thinking. Then by

strengthening ways of thinking, in this case as designers, the focus transitions from tools and procedures to values and ways of working. In other words, it is not necessarily learning about and how to use, for example, personas, but learning the value and relevance of being SC and empathic. It is not about using Legos bricks but understanding that we think and communicate differently through materials, that expressing untangled concepts (such as feelings) might be easier by using visual thinking and that a little piece of Lego might trigger a totally different way to understand a situation or generate an idea.

Design principles to support teachers in becoming designers

In this section we present five design principles to be considered when working with interventions for TasD, which respond our second research question: how to facilitate professional development activities to prepare teachers to become designers?

Principle 1: Create learning experiences for teachers by introducing TasD to concrete design models and tools.

Our field test supports the use of concrete design models to help teachers manage the messiness of the design process and create a structure to understand design processes, as the literature presents several design processes. Having concrete tools (such as the canvases) for each of the design steps provides actionable knowledge for teachers. However, as designers, we also need to be critical of the conceptualisations, which are materialised in the supporting tools, for example reflect on the use of the metaphor of 'courses'. This principle of providing concrete tools aligns with the works of (Brown et al., 2020; Henriksen et al., 2020; Yeoman & Carvalho, 2019).

Principle 2: Facilitate genuine learning experiences through participation in a creative and collaborative problem-oriented process based on teachers' own realities.

This principle is aligned with the work of Henriksen, Gretter, and Richardson (2020), who indicate that teachers might change their view and meaning of teaching as design science if they experience a real design process using their own practice problems.

Principle 3: Explicitly emphasise designerly ways of thinking.

It was evident from our pilots that the participating teachers did not consider themselves designers. However, when they were first introduced to the concept and then participated in the different activities, the demonstration of attributes such as empathy for students, metaphorical thinking, visual thinking, problem roots, thinking with Legos, co-creation and critical reflection, they started to understand the relevance. Processes and tools of design thinking are grounded in a set of mindsets which originate from a culture of a specific way of thinking (Schweitzer et al., 2016).

Most of these ways of thinking are closely related to the practice that teachers as professionals already perform; however, we argue that design thinking mindsets should more explicitly become part of teachers' values.

Principle 4: Provide physical, social and temporary learning spaces that allow for co-creation, embodiment and sensemaking with others.

The influence of space on the learning process (Bøjer, 2021), knowledge creation (Nonaka & Takeuchi, 1995) and innovation and creativity (Kohls, 2019) is well documented. Physical space affects how people think and behave and how and with whom they interact; therefore, when we engage teachers in a set of activities to foster the transformation to designers, the space (physical and digital) should be designed to facilitate the kind of interactions and knowledge creation that we intend to support.

Principle 5: The purposive use of materiality in design is an important element in bringing teachers closer to being designers.

Thinking through materials facilitates conversations, creates knowledge, fosters participation, facilitate to convert tacit knowledge into explicit and enables the formation of innovative spaces, among other purposes. Many teachers are used to oral communication; therefore, working with Legos, Post-it notes, sketching tools, card sorting materials supports the externalisation of thoughts and fosters creativity, communication, understanding and co-creation. Thinking through materials supports the immersion of teachers into the practice of designers and enhances the experience.

Conclusions

In this work we used DBR to create a teacher professional development intervention that helps teachers to become designers and to design SC-e-learning activities. The proposal includes specific tools, a concrete set of activities, a set of ways of thinking to be promoted and a set of design principles to be considered in future interventions.

The intervention was tested in two different settings in East African universities, demonstrating that the method has the necessary qualities to achieve the expected goals. The intervention is the first step in the journey of training teachers to become designers. The best way to develop teacher as designer skills is by performing the role as a part of everyday practice – in other words, by approaching real complex problems and addressing them with a design mindset and design approach. While we observed that teachers related quickly with the new design practice and recognised that they as teachers do design in different ways, the intervention also documented that the development of design skills and mindsets demands time, resources and a willingness to change on the part of both teachers and institutions (Rylander Eklund et al., 2022).

Most of the teachers were immersed in a social practice that has some design traits, but it is not practiced as a design craft. Therefore, becoming TasD demands a transformation in the way that teachers understand their own practices in relation to the design practice (practice and the cultural context in which the design thinking methods and mindsets emerge) to get the full potential of applying a design perspective to current teaching practices.

In this respect we note the need for further research to map and compare the epistemological traditions of learning, design and teaching practices to obtain a better understanding of TasD. There are many shared values of constructivist, experiential and situated learning theories and design practice. These shared values are applied by teachers when teaching but not when designing for learning. Explicit examples of certain learning theories that can be reformulated in design for learning might provide a meaningful learning experience for teachers, as it might help them connect previous knowledge to a new practice (design).

We consider that our prototype provides good scaffolding for the teachers to become designers; however, we should be careful not to fall into 'lobotomy', a metaphor used by Verganti (2017) to refer to a practice in management of making design thinking so digestible that it eradicates the creative power of designers. We need to find a balance to keep ambiguity, emotions, intuition, confusedness, play with images, metaphors, storytelling, the prototype and sensemaking of the design practice while still helping teachers to get relevant outcomes for their practice.

Finally, we recommend further research on TasD mindsets, supporting teachers to incorporate design into their teaching practice. Some sound studies have defined design thinker mindsets (Baran & AlZoubi, 2023; Brown et al., 2020; Vignoli et al., 2023), but a well-elaborated mindset for TasD has not been elaborated. We consider that the Scandinavian literature on IT didactic design (Levinsen & Sørensen, 2019) may contribute to developing a framework for a TasD mindset.

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References

Altena, S., Hinze, R., Poulsen, M., Parrish, S., & Dominique, R. (2019). *Many hats one heart": A scoping review on the professional identity of learning designers*. 359–364.

Baran, E., & AlZoubi, D. (2023). Design thinking in teacher education: Morphing preservice teachers' mindsets and conceptualizations. *Journal of Research on Technology in Education*, 1–19. https://doi.org/10.1080/15391523.2023.2170932

Bennett, S., Lockyer, L., & Agostinho, S. (2018). Towards sustainable technology-enhanced innovation in higher education: Advancing learning design by understanding and supporting teacher design practice. *British Journal of Educational Technology*, *49*(6), 1014–1026. https://doi.org/doi:10.1111/bjet.12683

Bøjer, B. (2021). Creating a Space for Innovative Learning: The Importance of Engaging the Users in the Design Process. In W. Imms & T. Kvan (Eds.), *Teacher Transition into Innovative Learning Environments: A Global Perspective* (pp. 33–46). Springer Nature Singapore. https://doi.org/10.1007/978-981-15-7497-9_4

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*(6), 1059–1076. https://doi.org/10.1111/bjet.12678

Bower, M., & Vlachopoulos, P. (2018). A critical analysis of technology-enhanced learning design frameworks. *British Journal of Educational Technology*, *49*(6), 981–997. https://doi.org/10.1111/bjet.12668

Brown, B., Friesen, S., Beck, J., & Roberts, V. (2020). Supporting New Teachers as Designers of Learning. *Education Sciences*, *10*(8), 1–14. https://doi.org/10.3390/educsci10080207

Camacho, H., & Dirckinck-Holmfeld, L. (2020). *Student-Centered e-learning Implementation A participatory Approach* (DLI Project, p. 16) [Project Report]. Access to Innovation. Student-Centered e-learning Implementation A participatory Approach

Camacho, H., Skov, M., Jonasen, T. S., & Ryberg, T. (2018). Pathway to support the adoption of PBL in open data education. *Design and Technology Education: An International Journal*, *23*(2), 1–19.

Chai, C. S., & Koh, J. H. L. (2017). Changing teachers' TPACK and design beliefs through the Scaffolded TPACK Lesson Design Model (STLDM). *Learning: Research and Practice*, *3*(2), 114–129. https://doi.org/10.1080/23735082.2017.1360506

Conole, G. (2013). *Designing for Learning in an Open World*. New York, NY : Springer New York.

Conole, G. (2014). The 7Cs of Learning Design – a new approach to rethinking design practice. In S. Bayne, C. Jones, M. de Laat, T. Ryberg, & C. Sinclair (Eds.), *Proceedings of the 9th International Conference on Networked Learning 2014* (pp. 502–509).

Conole, G., & Weller, M. (2008). Using Learning Design as a Framework for Supporting the Design and Reuse of OER. *Journal of Interactive Media in Education*, *1*(5), 1–13. https://doi.org/10.5334/2008-5

Conole, G., & Wills, S. (2013). Representing Learning Designs—Making Design Explicit and Shareable. *Educational Media International*, *50*(1), 24–38.

Cross, N. (2011). *Design Thinking: Understanding How Designers Think and Work*. Berg.

Dalziel, J., Conole, G., Wills, S., Walker, S., Bennett, S., Dobozy, E., Cameron, L., Badilescu-Buga, E., & Bower, M. (2016). The Larnaca Declaration on Learning Design. *Journal of Interactive Media in Education*, *1*(7), 1–24. http://dx.doi.org/10.5334/jime.407

Frick, E., Tardini, S., & Cantoni, L. (2013). *White Paper on LEGO®SERIOUS PLAY® A state of the art of its applications in Europe* (p. 29) [Project Report]. S-Play Project.

Gachago, D., Morkel, J., Hitge, L., van Zyl, I., & Ivala, E. (2017). Developing eLearning champions: A design thinking approach. *International Journal of Educational Technology in Higher Education*, *14*(1), 30. https://doi.org/10.1186/s41239-017-0068-8

Garreta-Domingo, M., Hernández-Leo, D., & Sloep, P. B. (2018). Education, Technology and Design: A Much Needed Interdisciplinary Collaboration. In E. Kapros & M. Koutsombogera (Eds.), *Designing for the User Experience in Learning Systems* (pp. 17–39). Springer International Publishing. https://doi.org/10.1007/978-3-319-94794-5_2

Gauntlett, D. (2014). The LEGO System as a tool for thinking, creativity, and changing the world. In M. Wolf (Ed.), *LEGO Studies: Examining the Building Blocks of a Transmedial Phenomenon* (1st ed., pp. 189–205). Routledge. https://doi-org.zorac.aub.aau.dk/10.4324/9781315858012

Goodyear, P. (2005). Educational design and networked learning: Patterns, pattern languages and design practice. *Australasian Journal of Educational Technology*, *21*(1). https://doi.org/10.14742/ajet.1344

Goodyear, P., & Dimitriadis, Y. (2013). In medias res: Reframing design for learning. *Research in Learning Technology*, *21*, 1–13. https://doi.org/10.3402/rlt.v21i0.19909

Groeger, L., & Schweitzer, J. (2020). Developing a Design Thinking Mindset: Encouraging Designerly Ways in Postgraduate Business Education. In G. Melles (Ed.), *Design Thinking in Higher Education: Interdisciplinary Encounters* (pp. 41–72). Springer Singapore. https://doi.org/10.1007/978-981-15-5780-4_3

Henriksen, D., Gretter, S., & Richardson, C. (2020). Design thinking and the practicing teacher: Addressing problems of practice in teacher education. *Teaching Education*, *31*(2), 209–229. https://doi.org/10.1080/10476210.2018.1531841

Henriksen, D., Richardson, C., & Mehta, R. (2017). Design thinking: A creative approach to educational problems of practice. *Thinking Skills and Creativity*, *26*, 140–153. https://doi.org/10.1016/j.tsc.2017.10.001

Kali, Y., McKenney, S., & Sagy, O. (2015). Teachers as designers of technology enhanced learning. *Instructional Science*, *43*(2), 173–179. https://doi.org/10.1007/s11251-014-9343-4

Kirschner, P. A. (2015). Do we need teachers as designers of technology enhanced learning? *Instructional Science*, *43*(2), 309–322. https://doi.org/10.1007/s11251-015-9346-9

Kohls, C. (2019). Hybrid Learning Spaces for Design Thinking. *Open Education Studies*, *1*(1), 228–244. https://doi.org/10.1515/edu-2019-0017

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S., & Ryan, M. (2003). Problem-Based Learning Meets Case-Based Reasoning in the Middle-School Science Classroom: Putting Learning by Design(tm) Into Practice. *Journal of the Learning Sciences*, *12*(4), 495–547. https://doi.org/10.1207/S15327809JLS1204_2

Laurillard, D. (2012). *Teaching as a Design Science—Building Pedagogical Patterns for Learning and Technology*. Routledge.

Levinsen, K., & Sørensen, B. (2019). Teachers' Designs for Learning Practices when Designing for Students as Learning Designers. *Designs for Learning*, *11*(1), 30–39. https://doi.org/10.16993/dfl.111

Lorenzetti, L., Azulai, A., & Walsh, C. (2016). Addressing Power in Conversation: Enhancing the Transformative Learning Capacities of the World Cafe. *Journal of Transformative Education*, *14*(3), 200–219. https://doi.org/10.1177/1541344616634889

Meinel, C., & Krohn, T. (Eds.). (2022). *Design Thinking in Education—Innovation can be learned*. Springer Cham. https://doi.org/10.1007/978-3-030-89113-8

Miranda, J., Navarrete, C., Noguez, J., Molina-Espinosa, J.-M., Ramírez-Montoya, M.-S., Navarro-Tuch, S. A., Bustamante-Bello, M.-R., Rosas-Fernández, J.-B., & Molina, A. (2021). The core components of education 4.0 in higher education: Three case studies in engineering education. *Computers & Electrical Engineering*, *93*, 107278. https://doi.org/10.1016/j.compeleceng.2021.107278

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Noh, S. C., & Karim, A. M. (2021). Design thinking mindset to enhance education 4.0 competitiveness in Malaysia. *International Journal of Evaluation and Research in Education*, *10*(2), 494–501. https://doi.org/DOI: 10.11591/ijere.v10i2.20988

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford University Press.

Reeves, T. (2006). Design research from a technology perspective. In J. Van den Akker, K. Gravemeijer, S. Mckenney, & N. Nieveen (Eds.), *Educational Design Research* (1st Edition, pp. 52–66). Routledge. https://doi.org/10.4324/9780203088364

Rylander Eklund, A., Navarro Aguiar, U., & Amacker, A. (2022). Design thinking as sensemaking: Developing a pragmatist theory of practice to (re)introduce sensibility. *Journal of Product Innovation Management*, *39*(1), 24–43. https://doi.org/10.1111/jpim.12604

Schon, D. (1983). *The Reflective Parctitioner: How Professionals Think in Action*. Basic.

Schweitzer, J., Groeger, L., & Sobel, L. (2016). The Design Thinking Mindset: An Assessment of What We Know and What We See in Practice. *Journal of Design, Business & Society*, *2*(1), 71–94. https://doi.org/10.1386/dbs.2.1.71_1

Simon, H. A. (1969). *The sciences of the artificial*. MIT press.

Tracey, M. W., & Hutchinson, A. (2016). Uncertainty, reflection, and designer identity development. *Design Studies*, *42*, 86–109. https://doi.org/10.1016/j.destud.2015.10.004

Tschimmel, K., Loyens, D., Soares, J., Oraviita, T., & Santos, J. (2017). *D-Think Toolkit. Design Thinking Applied to Education andTraining.* Erasmus+. https://www.researchgate.net/publication/320197120_D-Think_Toolkit_Design_Thinking_Applied_to_Education_and_Training/citations

Tsoukas, H. (2009). A Dialogical Approach to the Creation of New Knowledge in Organizations. *Organization Science*, *20*(6), 941–957. https://doi.org/doi.org/10.1287/orsc.1090.0435

Verganti, R. (2017). Design Thinkers Think Like Managers. *She Ji: The Journal of Design, Economics, and Innovation*, *3*(2), 100–102. https://doi.org/10.1016/j.sheji.2017.10.006

Vignoli, M., Dosi, C., & Balboni, B. (2023). Design thinking mindset: Scale development and validation. *Studies in Higher Education*, *48*(6), 926–940. https://doi.org/10.1080/03075079.2023.2172566

Warr, M., & Mishra, P. (2021). Integrating the discourse on teachers and design: An analysis of ten years of scholarship. *Teaching and Teacher Education*, *99*, 103274. https://doi.org/10.1016/j.tate.2020.103274

Yeoman, P., & Carvalho, L. (2019). Moving between material and conceptual structure: Developing a card-based method to support design for learning. *Design Studies*, *64*, 64–89. https://doi.org/10.1016/j.destud.2019.05.003

Young, C., & Perovic, N. (2018). *Introduction to the ABC LD workshop* (Project Report 1; HEFCE Action for Curriculum Excellence Project 2016-18, p. 17). UCL.