ORIGINAL RESEARCH

Innovation in Learning Design Within the Zone of Proximal Implementation: Developing Technology-Enhanced Learning Scenarios for Cancer Professionals

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Abstract

Technology-enhanced learning (TEL) is a domain-dependent field of expertise, and it is a challenge to transfer the intellectual richness of TEL research to new fields of application and to develop targeted educational formats. In our current research project, we faced the challenge of developing TEL scenarios for an inter-specialty training program for European cancer professionals, including different medical specialties and allied healthcare staff. Our goal was to provide innovations within the zone of proximal implementation with a realistic change to be implemented in educational practice. In this paper, we propose and report on a three-step requirements and design process called LICASA (Literature review, Curriculum analysis, Stakeholder analysis), which we implemented to follow a systematic approach in collaboration with domain experts for the grounded development of TEL scenarios. This three-step process consists of (1) a systematic literature review, (2) an analysis of an underlying competence model and estimation of instructional complexity, and (3) a survey-based study in which the current skills and experiences of the target group are analyzed. The motivation and theoretical background behind the development of the LICASA framework are reported. An exemplary application of LICASA in the current project is provided, conclusions are drawn, and challenges are identified.

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1 Introduction

A core challenge in technology-enhanced learning (TEL) is aligning general TEL principles with the specific demands of target contexts and domains. Research shows TEL being applied across varied educational contexts—formal, non-formal, and informal—and in fields ranging from school education to professional learning (Kalz & Specht, 2014). Due to TEL inherently cross-disciplinary bringing computer science, psychology, and education all together, its diverse methods and epistemologies can be difficult to communicate to domain experts without TEL expertise (Kalz, 2015). Frameworks like Technological Pedagogical Content Knowledge (TPACK) (Koehler & Mishra, 2009) attempt to bridge this complexity.

The TPACK framework conceptualizes teachers' digital teaching skills as compositions and intersections of technological knowledge, pedagogical knowledge, and content knowledge (Koehler & Mishra, 2009). This framework was developed based on the work by Shulman (1987) who earlier introduced the idea of Pedagogical Content Knowledge (PCK) in the 1980s in the discourse on instructional design (Bromme, 1995). In other countries with different didactical traditions, e.g. Germany or Sweden, this concept is also known as "Fachdidaktik" (Vollmer, 2014) and refers to the specific didactic knowledge that is required to teach in a domain and that stems from the knowledge structure encapsulated in the subject. In the application process of general TEL principles to a new knowledge domain, these general principles, the topic-related knowledge structures, and specific didactic approaches, need to be identified and aligned. Therefore, subject matter experts (SMEs) are crucial to represent the content knowledge while developing TEL scenarios in practice, specifically in the context of professional development where instructional designers are involved and manifest themselves as representatives of pedagogical and technological knowledge areas.

Previous studies usually focus on developing training programs and digital materials starting from content/knowledge-related needs of the learners. The current study emerged from a European project called INTERACT-EUROPE aiming at developing an inter-specialty training program for cancer healthcare professionals to foster communication and collaboration among stakeholders during the cancer continuum of people with cancer or affected by cancer. While domain-specific learning outcomes were developed by SMEs using qualitative and quantitative methods (Benstead et al., 2023), we, as instructional designers, were tasked with developing innovative TEL scenarios for this inter-specialty cancer training program.

This division of roles created a design knowledge gap between domain experts and instructional designers, which in turn led to two main challenges, prior to the design of the TEL scenarios: an unusual starting point in the design process and unfamiliarity with the domain context. The first main reason existing TEL design models did not fit our context was that, due to the separation from SMEs and limited direct interaction, we as instructional designers were unfamiliar with the educational context of the domain. Even though there are numerous existing approaches supporting the application of TEL knowledge to new domains, they lacked to guide our understanding of the learners, educational environment, and feasible instructional strategies—particularly in a setting where the content was highly specialized and new to us. The second challenge was related to our point of entry into the design process. TEL design models typically assume that instructional designers are involved from the outset, particularly in defining learning outcomes and shaping instructional goals. However, in our case, the domain-specific learning outcomes were already

developed by SMEs prior to the instructional design phase. As a result, we entered the process at a later stage, yet without the scaffolding and alignment typically provided by TEL models at that stage. To bridge this gap, a process was needed that would help instructional designers understand the domain's educational context and envision feasible innovations grounded in practice—not just theory or technological potential.

To avoid typical failure factors for technology innovations in education—such as culture gaps, reliance on all-in-one solutions, and lack of responsibility among project members/non-members (OUNL, 2005)—we sought an approach to support us in getting familiar with the educational context as instructional designers but also in understanding what is possible for the implementation of the TEL innovations in the prospective teaching/learning environment. Therefore, this conceptual paper provides a framework for designers for innovation within the zone of proximal implementation. As described by McKenney (2013), "studying the status quo of teaching, learning and settings, and designing TEL such that it gradually bridges from the current situation to the desired situation, is essential in developing both the knowledge and the tools required to address real needs in today's classrooms". To design effective TEL scenarios in fields like oncology education, instructional designers must navigate this disciplinary gap (Gottler, 2023) and operate within a zone of proximal implementation, where TEL methods are adapted collaboratively to the domain's unique requirements.

2 Aim of the Study

Our main goal is to support the implementation of innovations that lead to context-sensitive, feasible educational innovation, and sustainable changes in practice, rather than idealized or overly complex solutions. Therefore, this conceptual paper addresses the research question: "How can instructional designers develop innovative TEL scenarios in unfamiliar subjects (e.g., oncology education) within the zone of proximal implementation?". To answer this question, the study pursues two main aims:

(1) to propose an approach for designing TEL scenarios in unfamiliar, multi-domain educational contexts,
(2) to demonstrate the application of the LICASA framework in a real-world context—in the case of digital oncology education—to show how instructional designers can develop feasible and contextualized TEL innovations.

The proposed LICASA approach aims to address some common challenges in TEL design. First, working within the zone of proximal implementation for TEL innovations shifts the perspectives of the instructional designers being too much at the state-of-the-art (technology-driven solutions) rather than the state-of-practice (actual teaching and learning realities) (Jacobsen & McKenney, 2024; McKenney & Reeves, 2020). By prioritizing the zone of proximal implementation—incremental innovation that teachers and institutions can realistically adopt with manageable support—this study shifts the design focus towards sustainability and domain-contextual relevance. Second, the LICASA framework builds on the Fachdidaktik tradition and the PCK framework, offering a way for instructional designers to gain insight into unfamiliar domains. It helps identify evidence-based theory–practice gaps, enabling more conceptual understanding of the contexts for instructional designers,

and supporting TEL innovations that are grounded in both educational design principles and domain-specific needs. Ultimately, this study contributes a practical tool for designing TEL scenarios in complex inter-disciplinary settings, advancing the field of instructional design beyond traditional domain boundaries.

In the next sections, we introduce related work and the zone of proximal implementation as the theoretical background of the paper. We then introduce the LICASA framework as a specific approach to realize innovative TEL scenarios within the zone of proximal implementation. Then, we provide examples from the context of oncology education. We finalize the paper by discussing the challenge of situating general principles of instructional design/ TEL in an application domain.

3 Background of the Study

3.1 Related Work

Earlier studies have proposed approaches and models to develop digital educational materials, digital training for learning in the workplace, and professional development programs. Ley (2020) discusses the critical role of content and pedagogical knowledge structures which are encapsulated in business processes, domain vocabularies and taxonomies, as well as competence descriptions and their interrelationship. Littlejohn and Pammer-Schindler (2022) reported on the impact of technology on work-based and workplace learning. The authors discuss the evolving nature of work practices and the resulting new requirements in which work and learning are neatly integrated processes supported by different technologies. Tynjälä (2013) proposed a model for workplace learning/professional learning which uses the three dimensions of presage, process, and product (3-P) based on prior work by Biggs (1996). Applying the 3-P model to workplace learning/professional learning means to deal with individual dispositions of learners, context variables, schemas, activities, and learning outcomes. On a more concrete level, Janesarvatan and Van Rosmalen (2024) have recently provided a narrative review of the application of the 4-Components model for instructional design (4C/ID) (van Merriënboer & Kirschner, 2018) in the design of virtual patients in dental education.

Design-based research (DBR) is a well-known methodological approach to support a long-term and cyclic interaction with domain problems and their stakeholders to inform theory-based and contextual solutions (Anderson & Shattuck, 2012). In addition, there are more specific approaches focusing not only on the design of learning scenarios but on technology development. Drachsler et al. (2012) introduce the Technology-Enhanced Learning Design Process (TEL-DP) starting with semi-structured interviews, followed by the development of personas, and finally, a group concept mapping study to support systematic decision-making. After these phases of identifying requirements, the authors continued with the selection of suitable open-source software, prototyping, and usability evaluation. Furthermore, several guidelines for the development of eHealth applications exist. For instance, the CeHRes roadmap (Van Gemert-Pijnen et al., 2011) deals with a formative cycle of contextual inquiry, value specification, design, operationalization, and evaluation to develop eHealth applications that show a good fit for purpose and alignment with the needs of stakeholders.

On the one hand, these approaches provide some possibilities to involve stakeholders in the development of context- and subject-specific solutions. However, the literature report that most of existing instructional design approaches/frameworks lack guiding while working with SMEs/specialists (Gottler, 2023). On the other hand, their innovation paradigm often remains rooted in an understanding of innovation which is following the state-of-the-art in research and technology, which could lead to a gap regarding the practical needs of the domain and context. Therefore, we would like to prevent solely concentrating on state-of-art rather than state-of-practice (Jacobsen & McKenney, 2024), instead provide pedagogical value-added solutions to the authentic problems in real life possibilities. For this purpose, we followed the concept of innovation within the zone of proximal implementation as the theoretical background for our study.

3.2 TEL Innovations Within the Zone of Proximal Implementation

McKenney (2013) states that most design approaches for TEL projects provide insufficient attention to curricular alignment, the level of expertise in the target setting, and the institutional implementation context. This highlights the distinction between what could be effective TEL in theory and what can be effective in actual practice. Furthermore, McKenney considers not only the detailed aspects of learning and instruction but also the broader contextual factors that influence whether and how innovations are understood, adopted, and integrated by educators and institutions. The author calls on designers of TEL to seek solutions that allow an incremental innovation process rather than a radical innovation approach.

The author proposes an approach for incremental innovation in the school context with a concept called the zone of proximal implementation. The basis of the idea is Vygotsky's concept of the Zone of Proximal Development, referring to the gap between what learners can achieve on their own and what they can achieve with the support of guidance or collaboration. Furthermore, McKenney (2013) refers to the zone of proximal implementation as the gap between what teachers and schools are able to implement on their own and what becomes possible with appropriate guidance or collaborative support. The author's approach is divided into three phases: (1) "before design", which involves defining the needs/context analysis, (2) "during design", which includes prototyping and formative evaluation, and (3) "after design", which pertains to summative evaluation.

We have followed the ideas of innovation within the zone of proximal implementation (McKenney, Kirschner & Voogt, 2012; McKenney, 2013) and have transferred this concept from the school settings to the context of professional learning/professional development. McKenney's proposal builds on several shortcomings of TEL (design) research identified in the literature, such as insufficient attention to educational (and professional) realities, overestimation of acceptance, and skills of stakeholders. In addition, the author argues that many TEL projects deal with early adopters (Rogers, 2003) as stakeholders for these innovations leading to a biased sample that is often not representative of the educational practices in which those TEL innovations should be later implemented. Instead, McKenney proposes to follow an approach called zone of proximal implementation and to work with representative learners, teachers, and learning settings. To assess how viable TEL solutions are, it was proposed to focus on four variables (McKenney & Reeves, 2012): value-added (more than the status quo), clear (how stakeholders see their involvement), compatible (with stakeholders' beliefs and cultures) and tolerant (for variations of use in educational practice).

3.3 The Context of the Study

In our project context (INTERACT-EUROPE), we had the task of developing TEL scenarios for the training and education of cancer professionals. The project members initially specified a collection of learning outcomes and expertise profiles for inter-specialty training for cancer healthcare professionals (Benstead et al., 2023). The aim of the training is to foster communication and collaboration among the professionals to improve patient-centered cancer care. The target group of the training program consists of different medical professions (physicians, nurses, nutritionists, pharmacists, etc. in oncology) and specialties (e.g. medical oncology, radiotherapy, radiology, surgery, cancer nursing), and all of them are expected to play different roles in the treatment and care of cancer patients. Our challenge was to align our general instructional design expertise to the knowledge, expectations, and skills of the diverse stakeholders and SMEs from the domain of cancer-care and cancer treatment.

A continuum of expertise ranging from oncology to educational technology represents the diversity of the innovation concepts within the zone of proximal implementation. Instructional designers and domain experts collaboratively bridge their respective knowledge areas to develop TEL scenarios in the project. Although it was quite a challenge, the different levels of expertise needed to clarify the importance of mutual understanding, such as shared terminology, pedagogical/andragogical concepts, and awareness of technological affordances, during the pre-development phase of TEL innovations in oncology education. Therefore, we believe that the necessity for the LICASA framework relies on the principles of scalability, sustainability, and serviceability for trainers, administrators, and institutions in integrating technology into the teaching/learning environments (Moro et al., 2023) by creating mutual understanding and getting familiar with the concepts of different domains. To assess the curricular context, skills, and knowledge related to TEL practices and level of technology-integration of the target domain, we have developed the LICASA framework considering our resources, limitations, and timeframe, which we introduce next.

4 LICASA Framework

Adopting the idea of innovations within the zone of proximal implementation (McKenney, 2013) as a starting point to develop TEL scenarios for the above-described project context, we have developed the LICASA framework. With this framework, we would like to propose a way of bridging the knowledge gap between domain experts and instructional designers. This addresses the engagement of the instructional designers in the before design phase (McKenney, 2013) of the instructional design, mainly focusing on need and context analysis for the potential unfamiliar settings. We consider the LICASA framework to support existing instructional design models/methods by structuring the distance between designers and SMEs to be able to propose realistic innovations in the learning domain, meanwhile creating a pathway for the designers to meaningfully connect the during design and after design phases (McKenney, 2013) of the innovation implementation.

The LICASA framework presented in Fig. 1 is a three-step approach to ensure that the design of TEL scenarios is aligned with four variables of the zone of proximal implementation including value-added, clear, compatible and tolerant (McKenney & Reeves, 2012):
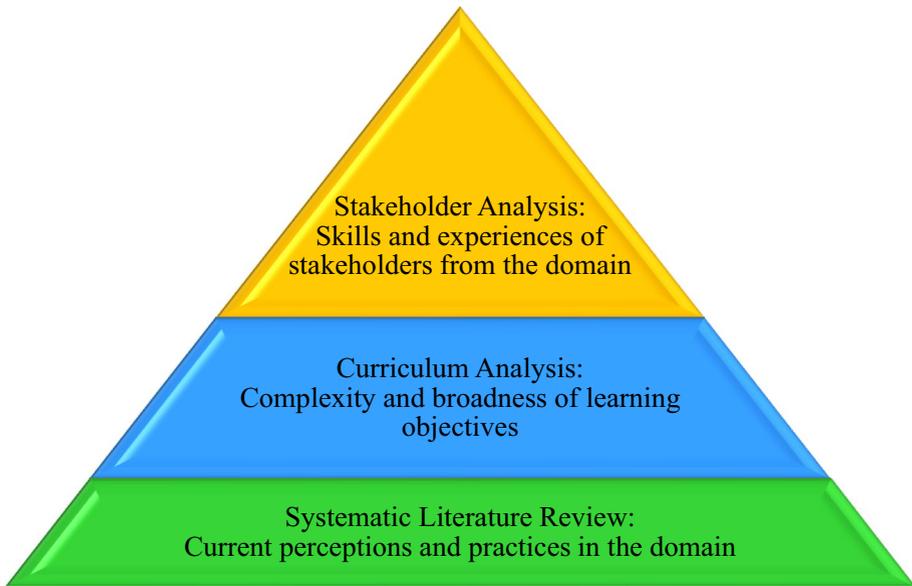
Fig. 1 LICASA framework

1. A *literature review* should identify common TEL practices in the domain and should ensure that the proposed scenarios are aligned with potential innovations within the zone of proximal implementation. A literature review should examine and highlight the typical TEL practices already used in the target domain (e.g., oncology education). The goal is to make sure that any proposed TEL scenario both fit within what is realistically adoptable in the current context and help make these innovations feasible for actual use. This step is also a proxy for the instructional designers to get involved and familiar with the domain and understand the concept of innovation in the field.
2. The *curriculum analysis* was used as a starting point or substitute to help understand the real-world complexity involved in designing potential learning scenarios. By analyzing the curriculum, the researchers/instructional designers aim to grasp what kinds of learning goals and content structures were already in place. The existing taxonomies (i.e., structured classifications of learning objectives and types of knowledge) can be used to build upon this understanding and guide the development of meaningful and contextually appropriate TEL scenarios.
3. The *stakeholder analysis* aimed at receiving representative impressions about the experiences, attitudes, and preferences of the potential stakeholders (e.g., learners, educators) of the project. The goal is to capture insights for instructional designers to be able to reflect the perspectives of different groups involved and ensure their views are included in the design process of the TEL scenarios.

The LICASA framework is implemented sequentially, while simultaneously reflecting the formative nature of the design process through the cumulative use of findings from each step. Specifically, LICASA is shaped step by step based on the outcomes of the literature review, curriculum analysis, and stakeholder survey, all of which contribute to a compre-

hensive understanding of the educational context. Rather than informing each subsequent step in a strictly linear manner, the findings from these phases are evaluated collectively and iteratively. This cumulative evaluation supports the development of TEL scenarios that are coherent, context-sensitive, and grounded in both empirical evidence and practical considerations.

Every single step guides the instructional designers to delineate the image of the TEL scenarios. The first step establishes a common understanding of the state-of-the-art in the specific domain in terms of digital education, while the second step helps to grasp the complexity of the content. Finally, stakeholder analysis contributes to revealing the potential participants' profiles, where their acceptance and satisfaction matter for the sustainability of the program. Overall, the development of TEL scenarios was a dynamic outcome informed by the ongoing refinement of the LICASA process. As each step neared completion, the results laid the foundation for the next step(s) of the framework. Consequently, the framework developed gradually, evolving from bottom-up and from a practical to the conceptual structure. The three components of the LICASA framework in Fig. 1 are presented in the following sections based on our project in the oncology education domain.

The first step in our approach consists of a systematic literature review and analysis of current practices of TEL applications in the target domain. This step is the basis for understanding how digital teaching and learning in oncology education is perceived and what major paradigms in terms of learning processes but also in terms of technologies are present in the current discourse in the field. To extend our understanding as instructional designers, regarding TEL in cancer professionals' education, we performed a systematic literature review (Kulaksız et al., 2023). Five main aspects were the basis of this literature review: (1) the type of digital tools used in the target domain, (2) the targeted skills of the professionals of the target domain with TEL, (3) the scope of research methodology, (4) the effects of TEL on teaching/learning processes in the target domain, and (5) publication patterns of research on TEL the target domain.

To understand the knowledge structures and complexity of the domain of study, we have in a second step conducted a curriculum analysis and mapping of defined learning objectives to different knowledge types and levels. A previous study on the scalability and complexity of instructional designs of MOOCs has informed our approach (Kasch et al., 2021). We used cognitive and affective learning objective domains, but also factual, conceptual, procedural, and metacognitive knowledge types (Anderson & Krathwohl, 2001). Each of these categories contain different levels of complexity. While this model of learning objectives can be regarded as a conceptual model without clear evidence behind it (Furst, 1981), it is useful to differentiate between e.g., a scenario that emphasizes knowledge transfer vs. a scenario that focuses on the application of knowledge. This kind of complexity analysis can also be conducted for the other categories of learning objectives.

In the third step, the stakeholder analysis provides evidence regarding potential learners' and educators' current states regarding TEL in oncology education including their practices and experiences with TEL. Potential participants of the project are described as learners and educators, who constitute two parts of the stakeholder analysis. Therefore, two surveys were designed, one for learners and one for educators. One of the important parts of the survey design was the compatibility of the two surveys to explore potential differences in the learners' and educators' understanding of digital education. The stakeholder analysis as a part of contextual examination aims at revealing an understanding of habits, opinions, beliefs, pri-

orities, and actual use behaviors of learners and educators, before starting the design of TEL scenarios (McKenney, 2013). In our case, we wanted to conceptualize and reveal intentions and usages regarding e-learning tools of learners and educators in the oncology education domain. We also believe that the digital teaching skills of cancer educators are important as they are the main actors in the online teaching process.

Overall, the LICASA framework was developed to support the formative design of TEL scenarios in unfamiliar professional contexts, such as digital oncology education. Grounded in the concept of the zone of proximal implementation (McKenney, 2013), LICASA aims to bridge the gap between domain experts and instructional designers through a sequential three-step process: a literature review to identify domain-specific TEL practices, a curriculum analysis to map knowledge structures and complexity, and a stakeholder analysis to understand the beliefs, needs, and practices of target users. These steps collectively inform the before design phase of TEL scenario development, ensuring TEL scenarios are contextually relevant and realistically adoptable. Each step produces actionable insights that shape the next, allowing for an evolving and responsive design process. Overall, the LICASA framework is a step-wise approach. However, the results of each step are used formatively for TEL design and development.

5 Application of the LICASA Framework to the Target Domain

We applied the LICASA framework step-by-step in the context of digital oncology education. The LICASA framework involved a series of design decisions that reflect specific methodological orientations for TEL scenario development. While the core LICASA framework provided the overall structure, we incorporated other conceptual models to provide specific rigor and relevance to each step in oncology education context. For instance, we used the PRISMA model for the literature review, employed a revised Bloom taxonomy for curriculum analysis, applied the UTAUT (Venkatesh et al., 2003) and DigCompEdu (Redecker, 2017) frameworks for stakeholder analysis, and adopted the design pattern model by Buendía García and Benlloch-Dualde (2011) for TEL scenarios. These specific frameworks and models are not part of the LICASA framework, meaning other studies might follow different conceptual models or frameworks more suited to their disciplinary areas or institutional settings. The results of each LICASA phase were used cumulatively to develop innovative TEL scenarios within the zone of proximal implementation for the INTERACT-EUROPE project, which aims to develop an inter-specialty training program for oncology healthcare professionals. The outcomes of each step are presented below and culminate in the development of the TEL scenarios.

5.1 Systematic Literature Review: Identifying Common Practices

The systematic literature review was conducted in order to identify the common practices in the field as an earlier research activity which has already been published as an independent publication (Kulaksız et al., 2023). The literature review was executed following the guidelines of the PRISMA model (Page et al., 2021). The search was strictly limited to empirical, peer-reviewed articles published in English between 2012 and 2022, focusing specifically on the context of TEL involving oncology healthcare professionals.

Analyzing 34 articles in the final phase, we observed a diversity of digital technologies used in oncology education (e.g. mobile apps, e-learning modules, e-performance support systems) despite a lack of cutting-edge educational technologies (e.g. simulations, AI-supported tools, AR/VR) in the results of this literature review. It was common to use a single tool instead of combining different applications to fit the course goals. Ready-to-use technologies were preferred; however, a limited number of studies developed or modified the digital materials regarding their learning objectives or contexts. The delivery mode of instruction was dominated by remote models, especially self-paced asynchronous and synchronous live lectures. We inferred from a detailed investigation of the studies that an introductory level of technology integration in oncology education was achieved, i.e., a substitutional change of traditional instruction to digital modes with no functional improvement (Puentedura, 2014). We perceived these results as a sign of a rather low level of digital competencies of the educators and a lack of educational technology support for their curricula at the institutional level.

It seemed to be a common approach that most of the professional development programs targeted the multidisciplinary participation of different oncology healthcare departments. We took these results as a good sign for our TEL scenario development, as our potential participants are very likely to be experienced with multidisciplinary educational activities. We also analyzed targeted outcomes of the training based on the CanMEDS framework about healthcare professionals' roles (Frank et al., 2015). These roles of healthcare professionals include being medical experts, communicators, collaborators, health advocates, leaders, scholars, and professionals according to Frank et al. (2015). Results showed that though there were many examples of subject matter knowledge (e.g., medical expert role), a lack of previous practice exists concerning soft skills (e.g., communication, collaboration, leadership roles). This gap in the literature remains a challenging point for us due to the limited reported examples.

The widely accepted Kirkpatrick's training evaluation model (Kirkpatrick & Kirkpatrick, 2016) in medical education was used to analyze the effectiveness of digital training programs. All papers reported positive or partially positive TEL experiences in cancer care education. More than half of the studies examined trainees' opinions regarding the usefulness of and satisfaction with digital tools. The findings indicated a step in the right direction for TEL in oncology education. However, the training programs usually included self-reported data collection tools, and a lack of evidence of the long-term effects of the training, real-life knowledge/skills transfer, and improvement at the institutional level (e.g., patient care, efficient workflow) was observed. Moreover, it was important for us to see documented challenges to be aware of potential challenges in our own practice. Our initial impressions are that TEL in oncology is mostly about knowledge transfer, supporting accessibility of materials, and overcoming time management issues via remote education modalities. Considering these limitations allows us to provide well-described TEL scenarios in an ill-structured domain.

There has been a growing trend in digital oncology education over the years. Comparing the different continents, Europe has fewer examples of digital training for cancer care professionals. Researchers in this domain are mostly familiar with mixed methods studies and show a tendency to a diverse use of data collection tools. It can be inferred from these findings that the current project fills an important gap in Europe's oncology education, initiating a leading training program including potential TEL scenarios. Furthermore, understanding

the variety of research methodologies serves as a collaboration opportunity in the context of research and development at the intersection of TEL and oncology education.

Overall, this literature review following the PRISMA model highlighted the state-of-practice of digital oncology education in the last ten years. The results including digital tools for learning purposes, targeted skills with TEL, impact of TEL on teaching/learning processes in the domain shaped our perspective regarding the domain of cancer care. These observations helped us become familiar with developing a common language with SMEs as we acted as instructional designers/researchers in the project. We intended to grasp the challenges (e.g., limited instructional design description and teaching/learning process implementation) that researchers and practitioners faced in the digital education of cancer care professionals. Discovering the practices and understandings of SMEs boosted the cooperation among the team in terms of concept clarity, real-life needs of cancer care professionals, their expectations, and limitations. Furthermore, it bridged the gap between practice and theoretical approaches. This scoping review provided our big picture of cancer care with digital education as a first step in the LICASA framework.

5.2 The Curriculum Analysis: Identifying Complexity

In the current project context, a document containing a list of 127 competencies (Benstead et al., 2023) as well as the literature review (Kulaksız et al., 2023) were the starting point for the development of TEL scenarios. Then, we conducted the curriculum analysis aiming to identify the complexity of the learning scenarios based on Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001). This taxonomy proposes three different learning objective domains as cognitive, affective, and psychomotor, and also a categorization of knowledge types ranging from factual knowledge, over conceptual knowledge, and procedural knowledge to meta-cognitive knowledge.

Table 1 summarizes the classification of learning objectives according to Bloom's Revised Taxonomy. The instructional complexity was analyzed by two researchers using a standardized form adapted from Table 1. The verbs (operators) within the defined learning objectives served as the primary proxy for identifying the corresponding knowledge categories and levels of those objectives. Disagreements between the two researchers were resolved through joint discussion. Subsequently, two SMEs reviewed the initial analysis and categorization of the learning objectives using an expert review form, which resulted in minor adaptations to the analysis. Following this feedback, the proposed curriculum structure based on (Benstead et al. 2023) was categorized according to each knowledge type and learning domain as shown in Table 1. We have identified all knowledge domains—except the psychomotor domain—and knowledge types in the project's curriculum. Finally, visuals were produced to summarize the defined professional roles for oncology healthcare specialists and their aggregated learning objectives to demonstrate the instructional complexity.

Table 1 Framework for complexity analysis of learning objectives based on Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001)

Level	Cognitive	Affective	Knowledge types
1	Remember	Receiving phenomena	Factual
2	Understand	Responding to phenomena	Conceptual
3	Apply	Valuing	Procedural
4	Analyze	Organization of values	Metacognitive
5	Evaluate	Internalizing values	
6	Create		

The curriculum analysis was mainly conducted to ensure the translation of professional profiles and skills in the domain of cancer treatment and care considering Bloom's Revised Taxonomy. The results demonstrated the complexity of learning activities required to reach the defined learning objectives. While some scenarios can be easily implemented with familiar technologies and learning activities, some others might currently be only feasible for combining digital professional formats with components of application of knowledge in practical scenarios. While there might be examples of the use of advanced learning technologies such as AR/VR, these solutions might not be feasible in practice due to a lack of availability in the involved training contexts or due to a lack of skills and experiences of the involved participants (see also results of the previous step—systematic literature review). Therefore, the complexity analysis for the curriculum also implies a proposal for the modality of teaching and learning and activity types. This contributes to the overall goal of a "viable innovation".

5.3 Stakeholder Analysis: The Skills and Experiences of Potential Participants

The stakeholder survey was conducted to identify the skills and experiences of potential participants in the project, either as learners or educators (Kulaksız et al., 2025; Steinbacher et al., 2025). Our aim was to capture a snapshot of the heterogeneity within the potential professional profiles in order to inform the development of compatible TEL scenarios, based on their experiences, beliefs, and intentions. To guide this process, the Unified Theory of Acceptance and Use of Technology (UTAUT) was adopted as the theoretical framework (Venkatesh et al., 2003), as it explains individuals' intentions and usage behaviors regarding technology.

Accordingly, we chose the sub-scales after generating a scale pool. To be straightforward and goal-oriented, considering the compatibility and economic limitations of the survey, it was decided to only include directly related variables/factors in the surveys. As a result, the surveys start with the background variables section, composed of demographic questions such as age, gender, language, country of residence, and profession. It is followed by prior experiences with e-learning, experience with different education modalities (e.g. synchronous, asynchronous education), and experience with learning technologies and formats (e.g., Learning Management Systems, mobile learning applications, digital simulations). The learner survey included variables such as performance expectancy, effort expectancy, facilitating conditions, behavioral intention for e-learning (Dečman, 2015), e-learning self-efficacy (Devisakti & Ramayah, 2022), and attitudes towards e-learning (Kuliya & Usman, 2021). The educator survey included the same variables and experience dimensions as the learner survey; however, the items were adapted to reflect the context of online teaching and the use of e-learning tools for instructional purposes. Additionally, the European Framework for the Digital Competence of Educators (DigCompEdu) (Redecker, 2017) was employed to assess the digital teaching competencies of potential educators. Therefore, the educator survey contained additional items specifically targeting the digital teaching skills required in oncology education (Alarcón et al., 2020). Feedback from domain experts was sought throughout the survey development process to ensure relevance and clarity.

The educators' and learners' experiences with digital learning and teaching tools were examined using a cross-sectional survey method involving 112 learners and 73 educators from across Europe (Steinbacher et al., 2025). Participants included cancer nurses, clinical

oncologists, medical oncologists, radiation oncologists, surgical oncologists, and pathologists. The mean age of the learners was 37.49, and the mean age of the educators was 47.18. The study results showed that both learners and educators were more experienced with synchronous and blended learning formats, yet they were less familiar with asynchronous and hybrid formats. Interestingly, learners preferred blended and hybrid learning, whereas most educators preferred synchronous delivery. These findings indicate that although asynchronous learning removes constraints of time and place, the limited familiarity with this modality required careful consideration. To avoid excessive cognitive load and ensure flexibility, synchronous and asynchronous learning components should be balanced in the TEL design. Learners and educators are more experienced with basic learning technologies, e.g., live lecture platforms, video tutorials, audio lectures, and e-books. Learners tended to have slightly more experience with these tools than educators. Surprisingly, both groups had minimal exposure to essential remote education platforms and tools (e.g., LMS, MOOCs, OER) as well as advanced technologies, e.g., mobile apps, simulations, and virtual reality. These results align with our initial impression of their previous experience. However, the challenge was to design learning activities aligned with intended outcomes while remaining compatible with users' existing skills. Therefore, we prioritized the integration of soft technologies such as LMS, e-books, podcasts, and videos, since both groups reported positive attitudes, high performance expectancy, and strong intentions to use online learning technologies (Kulaksız et al., 2025). We strategically incorporated a limited number of advanced technologies to stimulate motivation without overwhelming users.

Taken together, these findings allowed us to distinguish the profiles of two key stakeholder groups and understand their prior experiences and preferences. The stakeholder analysis relied on survey data from a representative sample of potential participants of the inter-specialty cancer training program, producing consolidated evidence that directly informed the scope of the TEL scenario design. To address the diversity of stakeholders' perspectives including different professions as educators and learners, the similarities and differences in their digital experience and expectations were examined. Discovering the diversity of potential educators and learners supported the identification of risks and opportunities of future TEL scenarios. Hence, we could identify (1) the modality of the instruction, (2) the selection of digital material types, and (3) make inferences about learning and teaching strategies and activities to develop TEL scenarios. Through this process, the stakeholder analysis served as a part of contextual elements for TEL design. It enabled us to align the instructional modality, technology selections, learning materials, and teaching strategies with the actual needs, capacities, and expectations of our heterogeneous user groups. In this way, the TEL scenarios were shaped to ensure coherence between learner needs and technological opportunities, fitting together like complementary pieces of a puzzle.

5.4 TEL Scenario Development: Final Destination

The phases of the LICASA framework led step by step to the TEL scenario development for the pre-defined curriculum representing inter-specialty training for oncology healthcare professionals. Contributions and implications of each step of the LICASA framework are presented in Fig. 2.

Fig. 2 illustrates the three-phase process followed for the instructional design of TEL scenarios in oncology education. The first phase of the LICASA process is directly related

to understanding current practices in oncology education in terms of technology use and instructional modes. This phase also served as a warm-up exercise for us as instructional designers to familiarize ourselves with digital oncology education and the jargon and terminology used by SMEs, in order to enhance the prospective curricula within the project. In the second phase, we dedicated ourselves to understanding the complexity of the training from an instructional design perspective and to extracting potential scenarios by analyzing the knowledge structures and complexity of the proposed curriculum, as well as constructing a conceptual model of the learning objectives. In the third phase, we aimed to understand potential participants' current practices, experiences, beliefs, priorities, and actual usage behaviors as learners and educators within the project. As a result, the findings of each step cumulatively shaped the TEL scenario development and entailed decisions regarding the development of TEL scenarios regarding design patterns, outlining the principles underlying the TEL scenarios, and categorizing the scenarios according to the developmental phases of instructional design.

The development of TEL scenarios followed a structured, step-by-step process, grounded in elemental, principal, and instructional foundations. First, we selected a design pattern to determine the key teaching and learning elements to be considered during the design phase. Second, we established the principal basis of the TEL scenarios at the organizational level, aiming to strike a balance between detail orientation and flexibility. This ensured that the scenarios could be adapted to participants' needs while accounting for the opportunities and
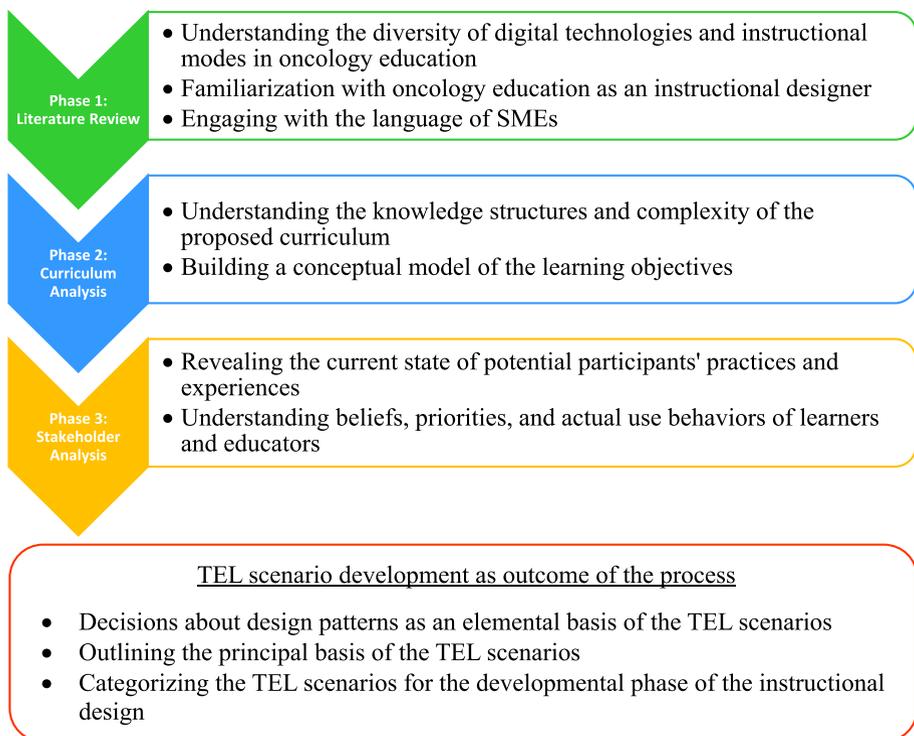
Phase 1: Literature Review
- Understanding the diversity of digital technologies and instructional modes in oncology education
- Familiarization with oncology education as an instructional designer
- Engaging with the language of SMEs

Phase 2: Curriculum Analysis
- Understanding the knowledge structures and complexity of the proposed curriculum
- Building a conceptual model of the learning objectives

Phase 3: Stakeholder Analysis
- Revealing the current state of potential participants' practices and experiences
- Understanding beliefs, priorities, and actual use behaviors of learners and educators

TEL scenario development as outcome of the process
- Decisions about design patterns as an elemental basis of the TEL scenarios
- Outlining the principal basis of the TEL scenarios
- Categorizing the TEL scenarios for the developmental phase of the instructional design

Fig. 2 Contributions and implications of the LICASA framework's phases to the TEL scenario development

limitations of the project. Third, the instructional principles were derived from the selected design patterns and organizational considerations. Based on this foundation, the TEL scenarios were then developed and categorized through competency mapping, incorporating both the design patterns and instructional principles. This structured approach provided a comprehensive and context-sensitive basis for designing effective TEL solutions tailored to the project's unique demands.

5.4.1 Elemental Basis of the TEL Scenarios: Design Patterns

The design pattern approach proposed by Buendía García and Benlloch-Dualde (2011) was used in this study. The authors employed a combination of text-based representation and graphical displays for learning design including contents, activities, interaction, and assessment concepts. The advantages of their method were that placing a learning scenario in an instructional concept map increases the flexibility and visibility of the learning design process. Therefore, their approach constituted the TEL scenario templates. Subsequently, we extended our TEL templates with design patterns as shown in Table 2.

Materials primarily consist of digitally developed learning resources such as text, figures, tables, graphs, videos, audios. Instructional methods encompass various learning and teaching activities in the training such as self-, group-, or trainer-led activities (e.g., essay writing, video recording, case presentation, case-based learning, and discussions). Interactions during the training are categorized into two types: interaction with static/dynamic content in a digital learning environment and personal interactions, e.g. with patients and colleagues. The modality of instruction/learning comprises three types of modes: (1) asynchronous, (2) synchronous, and (3) face-to-face. The learning designs according to the modality of learning are as follows:

Asynchronous mode of learning:

- Self-study: Learners proceed at their own pace in learning units driven by the static content in the learning system without trainer. Supervision of the learners is not required.
- Assessment: Learners join the assessment and evaluation process individually. They interact with static or dynamic measurement tools and content. Assessment and evaluation can be managed by the system or trainers.
- Group study: Learners connect to their peers in the system to accomplish certain tasks within a course. This sort of learning does not involve regular interactions with a trainer. It is usually supported or led by the learning system.
- Self-reflection: Learners are involved in trainer-led offline learning activities in order to

Table 2 Design patterns for TEL scenarios

Modality	Materials	Instructional methods	Support	Interaction
Asynchronous	Text	Expository learning/direct instruction	Self-study	Content (static/dynamic)
Synchronous	Figures	Case-based learning	Group-study	Learners
Face-to-face	Graphs	Exploratory learning	Trainer-led activities	Teachers
	Animations	Problem-based learning	Tutored	
	Videos	Mastery learning		
	Audio	Collaborative		

reflect on their self-assessment and discover their individual paths/attitudes/behaviors in specific topics. Guidance and materials assist learners' self-regulated learning approach.

Synchronous mode of learning:

- Group study: Learners communicate with their peers in the system during live lectures to complete specified tasks in the course. This learning type requires learners to attend the instructional activities together with their peers at the same time. It is usually supported or led by the trainers.
- Self-reflection: Learners are involved in trainer-led online learning activities in order to reflect on their self-assessment and discover their individual paths/attitudes/behaviors in specific topics. Interaction with trainers and peers supports learners' self-learning process.

Face-to-face learning:

- Practice at the clinics: Learners join face-to-face instruction or observation activities (shadowing). These events are led by trainers in their practical learning process in their clinics/departments or other related institutions during their rotational education.

5.4.2 Principal Basis of the TEL Scenarios: Blueprint Towards Development

Considering the findings of each phase of the LICASA framework and the experiences of the researchers of this study, some fundamental principles were raised in order to develop TEL scenarios for cancer healthcare professionals' inter-specialty training:

- *Flexibility and accessibility should be a priority*. This would mean that whenever possible a digital format would be offered which could be studied independently of location, time, and context.
- *Constructive alignment as a quality component should be reached*. The learning objectives, learning activities, and assessment methods should be aligned with participants' prior learning and readiness levels.
- *Technological simplicity*. Whenever standard learning technology can be used, it should be used. Therefore, the selected digital tools must be compatible with existing technological infrastructures and participants' digital skills.

5.4.3 Instructional Basis of the TEL Scenarios: The Types of Scenarios

Based on these design patterns and principles, we developed TEL scenarios that can be reused in several parts of the inter-specialty cancer training program. After conducting a literature review and analyzing the curriculum in the first and second step of LICASA, we initially defined three different TEL scenarios: (1) knowledge transfer, (2) decision-making support, and (3) exercising professional practice. However, upon attempting to classify the full set of modules, it became evident that this classification was not comprehensive enough. For instance, decision-making cannot be regarded as detached from professional practice and it was recognized that affective components might require a different teaching approach

Table 3 Overview of TEL scenarios

Scenario	LO domains/levels	Knowledge type
Low-level cognitive knowledge acquisition	Cognitive (Level 1, 2)	Factual, conceptual, procedural
Low-level cognitive knowledge application	Cognitive (Level 3)	Factual, conceptual, procedural
High-level cognitive knowledge acquisition	Cognitive (Level 4, 5, 6)	Factual, conceptual, procedural
Affective knowledge acquisition	Affective (Level 1, 2, 3, 4, 5)	Factual, conceptual, procedural
Metacognitive knowledge acquisition	Cognitive (All levels), Affective (All levels)	Metacognitive

than cognitive components. Consequently, the initial classification of scenarios had to be adjusted.

To refine the initial scenarios, the results of the curriculum analysis based on the Revised Bloom's Taxonomy (Anderson & Krathwohl, 2001) (see Table 1) were employed to compare the initial scenarios for each module with the different levels of complexity in cognitive and affective competencies. The comparison revealed a pattern, such as knowledge transfer scenarios aligning with cognitive learning outcomes at levels 1 (remembering) and 2 (understanding), while professional practice scenarios matched with cognitive levels 4 (analyzing). Based on this analysis, it was decided to realign the scenarios with the previous competency mapping. Ultimately, five learning scenarios were identified as presented in Table 3: (1) Low-level cognitive knowledge acquisition, (2) Low-level cognitive knowledge application, (3) High-level cognitive knowledge acquisition, (4) Affective knowledge acquisition, and (5) Metacognitive knowledge acquisition.

6 Discussion and Implications

In educational design research, a common pitfall is prioritizing the state-of-the-art in educational technology over the state-of-practice (Jacobsen & McKenney, 2024). When technology becomes the starting point, rather than the actual context and complexity of the educational environment, the result often leans toward "solutionism," where innovations are created in search of a problem (McKenney & Reeves, 2020). As Reeves and Lin (2020) argue, educational research must shift its focus from technological tools to meaningful, emergent, and context-specific problems. This critique resonates especially in intervention studies that overlook the real-world constraints and variability of teaching and learning environments (McKenney, 2013).

Furthermore, the distance of the instructional designers to the subject-domain requires some familiarization process to propose and build the innovation within the domain. This distance may arise from a lack of collaboration between different specialties, differing understandings of "technology" and "innovation" for teaching and learning purposes, challenges in achieving meaningful technology integration, or the instructional complexity of the respective domain. Ultimately, there is a need to bridge "content knowledge", "pedagogical knowledge", and "technological knowledge", particularly because of dealing with TEL. Therefore, the designers of training programs play a key role in aligning these forms of knowledge within specific educational contexts. However, the interdisciplinary nature of the instructional design can reveal some tensions between designers and SMEs (Blick and & Water, 2021; Gottler, 2023).

These needs for contextual alignment informed the development of the LICASA framework. In contrast to disruptive innovation models (Christensen et al., 2013), which promote replacement-based change, LICASA builds on the concept of innovation within the zone of proximal implementation (McKenney, 2013). This concept emphasizes gradual, supported change aligned with what institutions and educators can realistically implement. Drawing on the Diffusion of Innovation Theory (Rogers, 2003), the framework recognizes that acceptance and implementation of innovations differ across target groups and depend on contextual compatibility.

The LICASA framework was developed to provide a sequential, but also formative approach for designing TEL scenarios in complex domains, in our case oncology education. Each step builds upon the previous one while cumulatively informing the next and TEL scenarios. The formative nature of LICASA lies in the use of the results for the TEL design and development. Rather than imposing rigid procedures, LICASA scaffolds scenario development through ongoing reflection and adaptation. This approach meets the call for constructive alignment (Biggs, 1996) by connecting learning objectives, instructional activities, and assessment strategies. Through iterative engagement with context—via literature review, curriculum analysis, and stakeholder feedback—the process allowed iterative decisions to emerge naturally. Creating innovative TEL scenarios in the zone of proximal implementation involving compatible, tolerant, clear, and value-added variables (McKenney, 2013; McKenney & Reeves, 2012), the three steps in the LICASA framework are as follows:

- The literature review supports the identification of the "value-added" of TEL scenarios. At the same time, it supports the identification of "clarity" due to proximal decisions that are within reach of the current practices in the field.
- The curriculum analysis supports the understanding of knowledge structures in the domain and the required "complexity" of learning activities. Furthermore, it supports the understanding of the context for a flexible and "tolerant" implementation (for example about learning in practice situations).
- The stakeholder analysis contributes to "clarity" but also "compatibility" with regard to the mindset, experiences, beliefs, and values of target groups of the training program. This aspect follows general instructional design procedures to align a training program with the concrete context of the application.

There are several practical implications for the LICASA Framework. LICASA is designed to support instructional designers in familiarizing themselves with an unknown or less familiar context innovation within the zone of proximal implementation *before* beginning the design process. In this sense, LICASA begins at the individual level from the "instructional designer" and with their experience, knowledge and familiarity with the subject, helping designers understand the macro-level landscape of the domain by mapping both the state-of-the-art and the state-of-practice. Although we applied this process to oncology education, the same approach can be used when instructional designers must develop TEL scenarios in any unfamiliar domain. Because LICASA foregrounds contextual alignment, domain engagement, and iterative refinement, it can support TEL development whenever designers must work within highly specialized domains where they do not initially possess insights about the content knowledge. In such fields—vocational training, professional development programs, or advanced study programs at the graduate level—, it is often difficult to find

professionals who simultaneously combine pedagogical, technological, and content knowledge. Addressing this gap may help reduce the tensions between instructional designers and SMEs reported by Gottler (2023), and LICASA can support teams in identifying TEL solutions that are feasible, acceptable, and pedagogically meaningful.

Another practical implication of LICASA, which is a potential challenge for its implementation across different domains, concerns economic constraints. The three-step approach presented in this paper requires considerable time and resources, which may not be feasible for all application contexts. However, in domains with high security or accuracy requirements (such as medicine), this level of effort may be justified due to the importance of standardization and accreditation of training programs. Therefore, scalability and contextual adaptation emerge as important considerations. LICASA is designed to be flexible, yet its formative evaluation of the results and context-sensitive processes may be resource-intensive in large-scale or highly dynamic environments. Institutions with limited access to stakeholders or fragmented collaboration structures may find some steps—particularly curriculum and stakeholder analyses—more challenging to operationalize. These frictions highlight that applying LICASA in other contexts may require deliberate facilitation strategies or institutional mechanisms that support communication and shared understanding. Additionally, practitioners of LICASA should possess at least a basic level of research methodology knowledge to conduct the three steps or to follow a systematic approach that allows them to combine results coherently. This may require an instructional designer with a postgraduate degree or a senior designer experienced in working across diverse learning and teaching contexts.

We strongly recommend that future researchers and practitioners test and further develop LICASA framework. In this study, we were unable to provide empirical validity regarding the *effectiveness* of the LICASA framework. However, future research should investigate whether LICASA is useful for instructional designers when supporting TEL scenario development in real-world settings. This could include qualitative studies with instructional designers who apply LICASA to gain deeper insight into the framework's practical usefulness and challenges, such as Gottler's (2023) study. Another avenue would be to evaluate the TEL scenarios themselves. In this context, two well-established quality criteria can be considered: internal validity and external validity (or ecological validity). For internal validity, the internal coherence of a scenario is crucial, highlighting constructive alignment of Biggs (1996). External validity or ecological validity defined as "the extent to which the environment experienced by the subjects in a scientific investigation has the properties it is supposed or assumed to have by the investigator" by Bronfenbrenner (1977, p. 516), relates to McKenney's (2013) critique of the gap between what is theoretically possible in TEL and what actually works in practice. However, it is widely acknowledged that the complexity of real-world environments cannot be fully captured through controlled or laboratory-based studies alone in education—hence Berliner's (2002) assertion that educational science is "the hardest science of all".

Last but not least, it is important to emphasize that the LICASA framework is not intended to replace or position itself as an alternative to existing instructional design models or research methodologies such as DBR, ADDIE, CeHRes, or 4C/ID. Rather, our aim is to highlight the distance that often exists between instructional designers and the state-of-the-practice and state-of-the-art within highly specialized domains. LICASA provides a structured pathway that helps designers engage meaningfully with a distant domain while also creating a zone of proximal

implementation for "viable innovations" tailored to that domain. In this sense, the framework supports *before* design phases such as needs and context analysis to be able to realistically inform both *during* and *after* the instructional design process (see Table 1 in McKenney, 2013, regarding researching TEL innovations within the zone of proximal implementation).

7 Conclusion

This study contributes a structured and cumulative design framework, called LICASA, for developing TEL scenarios in specialized domains, in the case of oncology education. The key contribution lies in how LICASA functions as a sequential implementation-wise, but also formative design process in terms of use of results. It suggests progressively building understanding through a cumulative sequence of literature synthesis, curriculum mapping, and stakeholder engagement by supporting instructional designers' domain familiarization. The LICASA framework enhances TEL scenario design by (1) anchoring innovations in contextual realities rather than technological potential, (2) creating alignment between design elements through iterative refinement of the results of each step, and (3) supporting adaptability to different disciplinary needs and stakeholder profiles. This framework offers a pathway for future work aiming to design TEL solutions for professional training contexts where educational complexity and user diversity are high. For research, this approach supports a balanced and systematic analysis of innovations. It will be of interest if the TEL solutions development with LICASA is a good method to balance between state-of-the-art and state-of-practice (Jacobsen & McKenney, 2024) with academic rigor. For practice, this approach fundamentally relies on current practices, domain knowledge, and the perceptions and skills of stakeholders.

8 Limitations and Future Directions

While the LICASA framework proved valuable in our study, several limitations should be acknowledged. Firstly, the development of LICASA relied on our instructional design expertise but also our relationship with the oncology education domain. The full implementation of the LICASA process is resource-intensive. While justified in high-stakes domains like medicine, it may not be feasible in all educational or institutional contexts without significant investment in time and coordination. We recommend that future research explores the adaptability of LICASA in other disciplinary areas, such as engineering, public health, or teacher education. Comparative studies could help refine the framework's processes and validate its broader applicability.

Secondly, The LICASA framework involved a series of design decisions that reflect specific methodological orientations for the TEL scenario development. For instance, we used the PRISMA model for the literature review, employed a revised Bloom taxonomy for curriculum analysis, applied the UTAUT and DigCompEdu frameworks for stakeholder analysis, and adopted the design pattern model by Buendía García and Benlloch-Dualde (2011). While these frameworks and models provided structure and relevance to each step in our context, they are not part of the LICASA framework. Therefore, other studies might follow different conceptual models or frameworks more suited to their disciplinary areas or institutional settings.

Thirdly, LICASA was designed as a sequential but also formative framework by nature due to the retrospective and contextualized use of the results. Therefore, it does not prescribe

fixed instructional principles. Its value lies in supporting structured inquiry and informed design decisions. However, its non-prescriptive nature means that replicability across different settings will require thoughtful adaptation based on contextual demands.

Fourthly, due to the heterogeneity in prior knowledge, experience, and specialization among learners and educators, the developed TEL scenarios may require adaptation by institutions or professional specialty in future developments. This points to another challenge, closely tied to the motivation for innovation within the proximal implementation: even thorough analyses cannot fully eliminate the complexity and heterogeneity of specialized domains. LICASA seeks to work *with* that complexity—rather than reduce it—by enabling instructional designers to make informed, contextually grounded decisions early in the design process. The current approach provides a general framework and stands as a starting point for the next *during* design and *after* design phases of TEL (McKenney, 2013), but more nuanced personalization mechanisms should be considered for broader application.

Finally, we must acknowledge that the developed TEL scenarios are intended to serve as a foundation for the follow-up project called INTERACT-EUROPE 100. This project aims to develop digital learning and teaching materials in seven languages, create an online learning environment, and implement this inter-specialty cancer training program in at least 100 cancer centers across Europe. The overarching goal is to "foster a patient-centred approach to quality cancer care through the promotion of multidisciplinary and multi-professional teams" (European Cancer Organisation, 2025). With LICASA, we aim to provide a strong starting point for this follow-up project, where the development, implementation, and assessment of the training program will take place.ancer Organisatio

Data Availability We did not analyse or generate any datasets, because our work proceeds within a conceptual approach.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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