Activity Theory as a Lens for Developing and Applying Personas and Scenarios in Learning Experience Design

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Theoretically-informed design is a hallmark of the field of learning and instructional design and technology (LIDT). Designing digital environments for learning on the basis of theory can lead to theoretically pure and potentially effective learning interventions, yet theory alone is insufficient to consider the myriad of issues that emerge while a learner is engaged in digitally mediated learning. As the field of LIDT shifts towards more human-centered design practice, the phenomenon of learning experience design (LXD) has emerged as a novel, multidisciplinary focus area. LXD equips designers with a range of useful methods for explicitly considering the learner within the learning context. Two methods that we argue are particularly well-suited for this are personas and scenarios. The development of personas and scenarios can be informed by activity theory, which provides a lens for holistically considering the technology usage context and the learner's role therein. The current article discusses the interplay of activity theory, personas, and scenarios, and illustrates how this can be potentially useful in learning experience design practice in two separate case examples. Implications are discussed.

Introduction

The field of instructional design has experienced a number of shifts that have influenced its focus, methods, and identity, ultimately reshaping and redirecting the field. Gagné's concept of instructional systems design gave way to the now-common moniker of instructional design, which in turn has been supplanted by the term learning design. These changes in terminology historically have been predicated by broader shifts in the philosophical underpinnings of the field. The roots of instructional systems design can be found in behaviorist theories of knowledge acquisition (Gagné & Briggs, 1974), which eventually led to more cognitivist perspectives (Schuh & Barab, 2008), which in turn gave way in the early 1990s to more constructivist approaches (Honebein, 1996; Jonassen, 1991). This consequently signaled a shift from more objective epistemological views to an understanding of knowledge as more subjective and individualistic (Ertmer & Newby, 2013). With this came a recognition of the centrality of the learner to the learning process, and a move away from traditionally more instructor-centric approaches (e.g., Soloway et al., 1994). Key to learner-centric approaches is a recognition of the learner as central to the design process.

Theorists have increasingly begun to extend beyond cognitive and behavioral approaches to education and towards elements of human-computer interaction (HCI; Gray et al., 2020). More recently, theorists have begun to embrace elements of user experience (UX), which is used to design technologies in human-centered ways that are engaging, functional, and user-friendly (McLellan, 2000; Schmidt et al., 2020). Borrowing practices from user experience design (UXD) and applying them to learning design practice has led to productive application of associated methods and processes, with clear, practical value for the design of digital environments for learning (Dimitrijević & Devedžić, 2021; Haldane et al., 2019; Matthews et al., 2017; Shernoff et al., 2020). When UX methods are applied in the field of LIDT, the focus on the user of a technology system necessarily shifts to a focus on the learner-as-user of a given learning technology, e.g., learning management system, serious game, virtual learning environment, etc. (Jahnke et al., 2020). The learner experience (LX), therefore, can be characterized as an emergent quality influenced by many aspects of the learner's interaction with the given learning technology (Hassenzahl & Tractinsky, 2006; Schmidt & Huang, 2021). These include ease-of-use, appeal, context of application, learner's goal orientation, etc.

There is little argument that digital environments for learning should be designed in a way that effectively

embodies learning theory and facilitates meaningful learning. However, designs of many existing digital environments for learning are conceived primarily from the perspective of a siloed learning theory. All too often, designers of such systems fail to consider the broader notion of LX (Gray, 2016). This is not to suggest a lack of expertise, but rather that considerations of LX from this more holistic lens has not been a central focus. This could be due to a myriad of challenges, including limited budgets, protracted timelines, a lack of buy-in with stakeholders, and so-on. Applying a siloed, narrow view of learning design introduces the risk of developing a digital environment for learning based on sound theory (e.g., cognitive load, cognitive flexibility) that lacks sufficient consideration of issues that are traditionally seen as more relevant to the field of HCI, for example, fluid navigation or minimalist design. This could lead to the design of a digital environment for learning that conveys the technical aspects of a content area, but is not necessarily enjoyable, pleasing, or easy to use. A purely theoretical orientation to design in itself might not take into account the myriad of variables that can influence a learner's individual experience while engaged in technology-mediated learning. For example, an interface, online course, or learning module that is difficult to use could impact learners' acceptance and perceived utility of the technology (Venkatesh et al., 2003) and ultimately could impede learning.

Learning designers are confronted by challenges on a range of fronts when attempting to apply UXD methods to learning design. One of the issues has to do with the lack of clarity around the concept of learning experience design (LXD). In the field of HCI, the term UX has become common parlance, although it is not well understood (Law et al., 2009). This is perhaps because UX consists of multiple variables that are not agreed-upon or consistently considered and because it lacks a coherent unit of analysis. In this sense, a parallel can be drawn between UX and LXD, in that terms and concepts related to LXD abound in practice, despite the lack of clear definitions and methodological frameworks (Schmidt & Huang, 2021).

Another challenge in LXD is how to contextualize individuals as they employ learning technologies. However, studies show that designers struggle regarding how to design the context that embodies the experience of users. In the realm of UX design, practitioners will often develop personas and scenarios to provide design context. These methods are equally valuable in learning design, as it is often difficult for designers to remain cognizant of the emergent needs of learners as they navigate the learning space, work with peers, and perform other learning tasks. Personas, in general, are archetypes of users who might employ the technology within their specific usage context (Miaskiewicz & Kozar, 2011). In learning design, specifically, personas are archetypes of learners who might engage in a learning activity using a learning technology (e.g., LMS, mobile app, serious game). Scenarios are narratives that describe user activity in a story format (Carroll, 2000). Both scenarios and personas can be incredibly valuable when employed for learning design.

We argue that personas and scenarios are a useful tool for situating learning designs within the lived experiences of individual learners. Traditionally, learner analysis and context analysis are recognized as critical aspects of instructional design . Articulating learner and contextual characteristics and deriving learner needs is most often performed within the context of front-end analysis. However, approaches to learner and contextual analysis can be quite general. Learner analysis methods tend to characterize learners based on measures relevant to a given content area (e.g., reading level, attendance, quiz results, performance metrics) and often are garnered through indirect means, for example from grade rosters or from interactions with subject matter experts (SMEs). Contextual analysis tends to take a narrow view, focusing primarily on the immediate context of learning (e.g., school, training program, etc.) as opposed to a broader conceptualization that might consider social, physical, and political factors. However, context plays a critical role in understanding the broader ecosystem that encompasses learning (Tessmer & Richey, 1997). Contextual factors are fundamentally and inextricably interconnected with learner considerations, such as prior knowledge, common experiences, shared social mores, etc. (Smith & Ragan, 2005). Socio-cultural factors shape cognition (Järvenoja et al., 2015), influence recall of prior knowledge and enhance meaning (Shepherd, 2011), and can promote transfer of knowledge and skills to novel situations (Tessmer & Richey, 1997). Our field has accepted that learners' operate and engage in meaning-making as negotiative practice within socio-cultural contexts (Brown et al., 1989). Indeed, "acts take their meaning in relation to the social worlds (or communities of practice or activity systems) in which individual actors participate and to the actors' positions or identities in those contexts" (Nolen, 2020, p. 1). Design methods that lead to deeper considerations of individual learners and take into account the broader socio-cultural ecology in which meaning-making is situated therefore could provide useful tools for instructional designers seeking to advance more learner-centered methods. To this end, personas and scenarios are promising; however, how they are situated more broadly within a design ecology must be articulated, which we discuss later in this paper.

The purpose of the current article is to highlight how one theoretical perspective that finds resonance in LIDT—activity theory—can be applied synergistically with specific methods of UXD—personas and scenarios—to

inform the design of digital environments for learning. We argue this synergy allows for embodiment of theory while concurrently promoting positive learner experiences. Activity theory provides parameters for contextualizing technology usage within a framework that not only considers the interaction of the learner with the technology tool, but also the broader context within which that interaction takes place. In the following sections, we briefly describe activity theory and how it informs iterative design of digital environments for learning in a UCD process. Real-world case examples from our own learning design practice are provided. We conclude with a discussion of implications, and consider how similar approaches might be adopted by others in the field.

Activity Theory

Understanding learners' experiences when engaged in technology-mediated learning could benefit from a more holistic perspective of HCI (Barab et al., 2004; Nardi, 1996). One theory that finds resonance in both HCI and LIDT is activity theory. Activity theory argues that activity and consciousness are dynamically and inextricably interrelated. The theory considers the broader context and culture from which learning emerges, and thus has important implications for describing how learners think and reason within the world around them, how they engage in meaning-making, and how they develop understanding within their social context. In the field of LIDT, Jonnasen and Rohrer-Murphy (1999) explained it thusly: "conscious learning emerges from activity (performance), not as a precursor to it. So activity theory provides us with an alternative way of viewing human thinking and activity" (p. 62). From an activity theory perspective, actions are purposeful, social, mediated, multilevel, and developed through interaction between subjects and the objective world (i.e., objects). In doing so, activity theory explicates a variety of constructs to detail how an individual uses tools within an activity system and social context to engage in goal directed behavior (see Figure 1). From an end-user perspective, activity theory describes the individual and his/her role as it relates to the intersection of tasks (activity) and group-level work (action). As s/he completes a given task with available tools, s/he engages in goal-directed behaviors through established rules, such as norms and processes. Alternatively, the community can connect to the object through division of labor (Yamagata-Lynch, 2010). The theory is thus descriptive in that it takes into consideration how individuals (a) manage the contextual constructs of division of labor, rules, and community and (b) employ technology for achieving specific outcomes.

Activity theory includes multiple LXD implications for designers of learning environments. First, activity theory as applied to LXD details explicit constructs important to the learning context, in juxtaposition to approaches that might focus more on a content-driven approach to learning design (e.g., flipped classroom). Rather than viewing content as a body of knowledge to be transmitted to the learner and subsequently attained, the cultural constructs of activity theory describe the broader context in which knowledge construction takes place. It follows that understanding this phenomenon requires one to critically consider the artifacts and technology that mediate that learning process (Kaptelinin & Nardi, 2018; Yamagata-Lynch, 2007) and how those constructs are situated and interoperate within elements of the activity system. Technology, therefore, is not only an instrument available to a learner for completing an action, but also plays a role in allowing meaning-making to emerge within a community (Barab et al., 2004). Therefore, meaning-making is not only an individual endeavor, but is also an emergent property of the entire activity system.

Figure 1

Activity system diagram

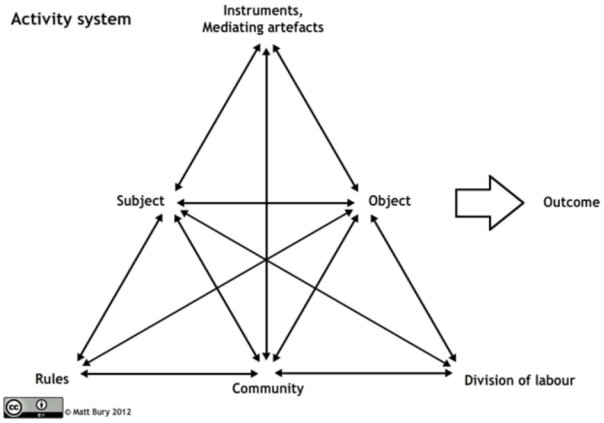


Diagram of an activity system as conceptualized by Engeström, illustrating connections between subject, instruments, object, and outcome, as well as rules, community, and division of labor.

(Engeström, 2000). CC BY 2.0.

Although most learning designers consider learners from the perspective of needs assessment, consideration is largely absent in learning design of how learning activities connect with the broader bounds of the learning community (Gray et al., 2020; York & Ertmer, 2011). Given activity theory's emphasis on activity as a multifaceted and mediated phenomenon between the subject, tool and object, it "prompts the designer to look beyond the immediate operation or action level and to understand the use of the designed tool in terms of the more comprehensive, distributed, and contextualized activity. This shift places emphasis on understanding not simply the subject but the entire context" (Barab et al., 2004, p. 203). As opposed to a narrow view of embodying a specific theory or model within a technology interface

(e.g., cognitive load theory; ARCS model), an activity theory lens considers requisite technology features for affording specific actions towards learning goals, including how to interact with peers and share responsibility for tasks. Moreover, it allows designers to consider how implementing and/or changing technology tools might impact social dynamics and the learning process. Adoption of an activity theory lens by learning designers, therefore, has the potential to promote a more holistic and comprehensive view of learning as goal-oriented meaning-making activity, mediated by technological tools, and circumscribed by the broader context of the learning community, its rules, and its division of labor.

Development and application of personas and scenarios using activity theory

Designers of learning environments often approach development from a learning theory perspective to engender self-directed learning, motivation, and other learning outcomes. However, socio-cultural approaches suggest that designers of these environments should not only consider theories that circumscribe our understanding of learning, but also the broader contexts in which learning occurs (Jonassen et al., 1994). Activity theory explicates how learners might operate and navigate activity during a social learning process, thus aligning with theories rooted in Vygotskian social constructivism (Vygotsky, 1978) such as distributed cognition or situated learning theory. Therefore, activity theory could prove to be a useful tool for learning designers when applied in conjunction with established design practices (such as in the development and application of personas and scenarios) to elaborate the broader ecology of learning with technology. As it relates to LX and personas, activity theory can provide a more comprehensive understanding of how learning technology is used, by whom, under what conditions, with what kinds of supports, and for what kinds of outcomes. This provides a lens for designers to consider a broad range of issues towards the development of a learning environment that considers not only effectiveness, but also efficiency and appeal (Honebein & Honebein, 2015). In the following sections we provide case examples detailing this.

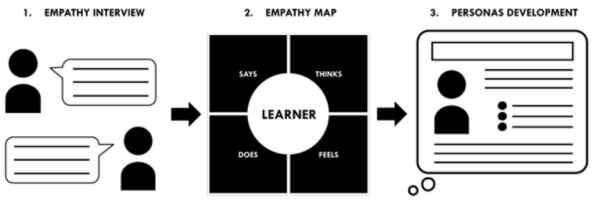
Case 1: Supporting Mobile Health Design Using Personas

Designing learning experiences within health contexts presents unique challenges. Learners are often patients with health conditions that impact their quality of life and general well-being. Stakes can be high, for example, for someone recently diagnosed with diabetes learning to take medications regularly to control debilitating symptoms, or for someone after sustaining a concussion learning how to gradually return to activities to improve recovery. However, learning designers seldom have direct experience with the myriad of health-related issues they may encounter in practice. Similarly, the SMEs with whom learning designers might collaborate (e.g., physicians, nurses) may have deep domain knowledge and practice-based experience but be professionally distant from the lived experiences their patients might face. In this case study, we describe how we used personas within our own design practice to promote empathy with patients and to better understand how we could design more holistically so as to meet their learning needs within their socio-cultural contexts.

Mobile health (mHealth) is defined as “the use of mobile computing and communication technologies in health care and public health” (Free et al., 2010, p. 1). mHealth applications have been shown to improve healthcare by reducing costs, promoting accessibility, and improving individualized treatment (Steinhubl et al., 2013). Increasingly, human-centered design approaches are being adopted to develop mHealth interventions, commonly referred to as patient-centered design (Chiauzzi et al., 2020; Hernandez-Ramos et al., 2021). Within this context, personas are often developed to guide design (Ayubi et al., 2014; Haldane et al., 2019). In our own mHealth design practice, we apply human-centered design methods within the frame of LXD. Our LXD process utilizes personas to guide mHealth design. Developing personas begins by performing empathy interviews with representative patients. Interviews are then transcribed, and salient quotes and topics are categorized using affinity mapping techniques (Lepley, 1999). These affinity maps are then used as inputs for developing patient personas (Figure 2), a process that bears some similarity to that described in Siricharoen (2021).

Figure 2

Process of creating personas through distillation of empathy interview data using empathy mapping techniques



Process model diagram illustrating how personas can be created using empathy interviews and empathy maps

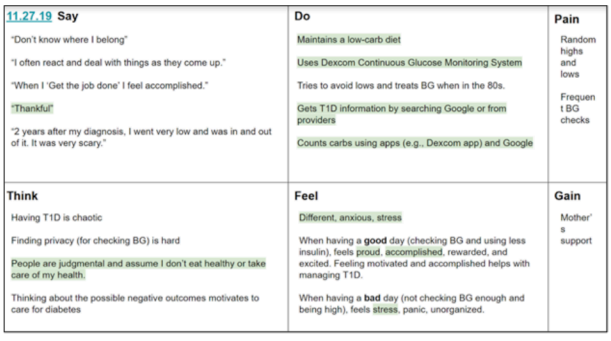
Our process of developing personas follows design thinking processes (Chokshi & Mann, 2018; Ector et al., 2020) that begin with empathy interviews and are followed by empathy mapping (Klamerus et al., 2019;

Weijers et al., 2021). Although techniques such as empathy interviews, empathy mapping, and development of personas are widely used methods in UXD and design thinking circles, application of empathy methods in the field of learning design is less prevalent, but has garnered some attention both in research (e.g., Mehta & Gleason, 2021; Morel, 2021; Tracey & Hutchinson, 2019) and in practice (e.g., C. Gray et al., 2015; Matthews et al., 2017). Empathy interviews and empathy mapping are methodological tools that provide a means to learn what is important to learners, to reveal emotional and perhaps tacit insights, to explore behaviors, needs, and challenges, and ultimately to develop a deep understanding for the daily lived experiences of target learners. Empathy interviews take the form of a series of open-ended questions tailored to the situation and target users. In general, empathy interviews are one-on-one conversations that elicit stories about specific experiences of interviewees. Although interview questions are personalized, following a protocol helps interviewers advance "the principles of being intentional, human-centered, and equity-focused" (Nelsestuen & Smith, 2020, p. 2). Different from other types of interviews, empathy interviews aim to promote empathy, which requires interviewers to immerse, observe, and engage during the interviews (Doorley et al., 2018).

To distill key information from empathy interviews into discrete categories, we employ empathy mapping techniques. Empathy mapping was originally developed as a tool for gamestorming (D. Gray et al., 2010). To create an empathy map, learning designers categorize interview notes based on what the interviewee was saying, doing, thinking, and feeling. The newly organized information helps designers focus on the interviewee's emotions and experiences—central elements of human-centered design. Figure 3 presents an example empathy map developed in the context of blood glucose management for type 1 diabetes.

Figure 3

Empathy map developed in the context of type 1 diabetes management

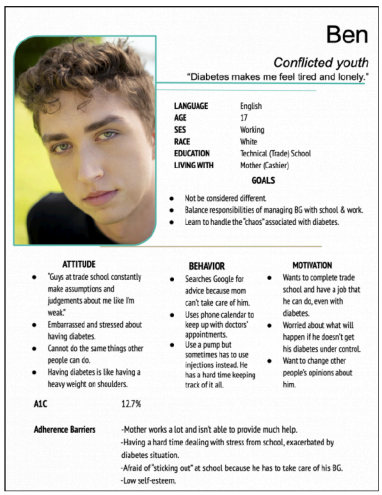


Example empathy map showing four quadrants, labeled "say," "think," "do," and "feel"

Following empathy interviews and empathy mapping, personas are developed. Within our three-stage process, personas are essentially artefacts of empathetic understanding that can be continually referenced across design phases. The multi-stage process of developing personas serves multiple purposes from a learning design perspective. First, the process brings the designer directly into contact with representative members of the target population and requires the designer to engage in deep, personal questioning so as to elicit aspects of everyday life and lived experiences of the people for whom the intervention is being developed. Next, because patients often relay intensely personal and challenging vignettes from their lives and how their quality of life has been impacted by health-related challenges, the experience can be visceral, emotional, and sometimes painful—descriptors that are not often associated with learning design. By eliciting participant narratives of lived experiences, learning designers are provided a lens through which empathy can develop, that is, they can develop shared understanding and experience with target learners by intentionally seeking to uncover details about other people's situations, feelings, and lived experiences. Finally, empathy interviews can serve as a conduit that can promote the emotional disposition of empathetic concern (Warren, 2018) and the cognitive dimension of perspective-taking (Gasparini, 2015) for LX designers. An example persona is provided in Figure 4.

Figure 4

Example persona of "Ben," an adolescent with type 1 diabetes who is struggling to manage his blood glucose levels



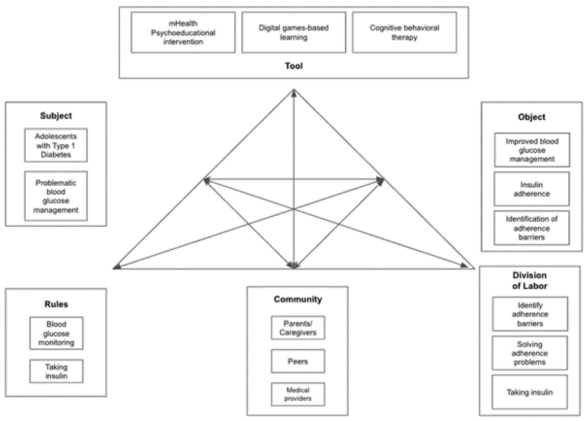
Example persona of a fictional user named Ben, an adolescent with diabetes. Persona includes information on demographics, attitude, behavior, motivation, and adherence barriers

Having established our process of persona development within the context of mHealth design, we now turn to theoretical considerations. Specifically, we consider how

personas help to frame learning design from an activity theory lens. Different aspects of activity theory provided inputs for development of empathy interviews, so as to uncover aspects of lived experience that may be more tacit. For example, in type 1 diabetes blood glucose management, identification of subjects, tools, and objects is rather straightforward. However, consideration of rules, community, and distribution of labor unveils challenges that interrelatedly complicate blood glucose management. For example, we learned from empathy interviews that supporting insulin adherence is a community endeavor with multiple subjects involved, including parents/caregivers, healthcare providers, and peers, and that division of labor requires effective communication, often supported by a range of technologies. How this manifests is highly individualized and often develops unintentionally based on reaction to emergent challenges. This, in turn, results in localized rules that often are tacit and sometimes ineffective. Drawing an example from the persona in Figure 4, Ben's mother is supposed to remind Ben before school to check his blood sugar and take insulin, but she sometimes is at work and is unable to remind Ben. Not only does this result in undesirable outcomes related to taking insulin, this simple deviation resonates across the entire activity system in unpredictable ways, which potentially can amplify these undesirable outcomes. This has ramifications for learning design, and provides an opportunity for learning designers to consider not only how interventions can be designed to ameliorate these issues, but also how the intervention influences not only the outcome of potentially improved medication adherence, but also communication between subjects (community), making rules explicit and applying them with fidelity (rules), and understanding who is responsible for what (division of labor).

Figure 5

LXD of Diabetes Journey learning environment through lens of activity theory



Activity theory diagram that has been annotated with specific details from the Diabetes Journey case example

Case 2: Supporting Case Library Design Using Scenarios

The case of Nick's Dilemma illustrates how a learning environment can be designed based on sound theoretical foundations, but nevertheless fail to be used effectively due to insufficient consideration of how learners would interact with the technology within their specific learning contexts. The authors of this chapter were involved in a multi-phase, design-based research project to develop an online case library that would support learners in problem-based learning (Schmidt & Tawfik, 2018; Tawfik & Jonassen, 2013). In this problem-based learning (PBL) environment, the student reads about how the protagonist, Nick, must hire a new individual for his sales team with his boss, Sheila. The ill-structured problem outlines how Nick and Sheila are under intense pressure as they increasingly lose customers to market competition. The learner is confronted with three potential solutions to mitigate turnover within their medical device sales team. The learner can either (1) hire an internal candidate, (2) hire an external candidate, or (3) advertise the position again in a local newspaper. Each option has a range of benefits and drawbacks that the learner must identify and consider in making a decision.

The design team used the theoretical lens of case-based reasoning (CBR) to support novices as they used the PBL environment, a theory that rests on the notion that individuals use prior experiences stored in long-term memory to solve new problems. When an individual lacks any relevant prior experience to reference, they can be provided curated stories from a database (called a 'case library') to serve as 'vicarious memory' (Kolodner & Guzdial, 2000). According to CBR theory, learners read these digital cases and then apply the lessons learned towards the main problem to solve (Riesbeck & Schank, 2013). A CBR approach to PBL therefore mitigates a novice's experiential gap and uses similar cases as scaffolds from which learners can draw lessons learned (Tawfik & Kolodner, 2016).

The design team did not explicitly develop personas during their design, but instead inferred what a typical user would be like from needs assessment. Findings from needs assessment suggested that learners were upper-level juniors and seniors enrolled in a postsecondary Sales Management course at a large midwestern university. Conversations with the SME unveiled a concern that learners were too focused on finding the "right" answer while meeting the minimum requirements of a given assignment, which led the SME to believe the students lacked the critical thinking skills needed for entering the workforce. From this, the designers inferred

that the “typical learner” would be a college student enrolled in the marketing class. This learner would use the learning environment as intended to access a set of hyperlinked cases to solve the problem faced by Nick and Sheila. By providing learners with cases, they would be able to encounter “vicarious memories” that would provide a stand-in for the real-world experience that the SME felt was lacking.

While the learning environment was designed to align with many aspects of case-based reasoning, the assumed student persona lacked sufficient detail to consider how the learning environment would be used in context. Specifically, we failed to consider the process of learning with PBL, group dynamics, classroom culture, and other factors. Again, activity theory allows us to construct a scenario for the persona. To re-imagine this persona and scenario through activity theory, the learner (subject) attempts to resolve the problem faced by Nick and Sheila (objective). Given that the students had little or no experience, the database of related stories (case library) serves as the tool needed to help accomplish the task. Upon reflection, the top half of the activity pyramid (subject, object, tool) is well articulated and described by the lense of activity theory.

While the interface technically aligned with the tenets of CBR, activity theory articulates ways to situate the persona within the scenario as it relates to the rules, division of labor, and community within the activity system (Figure 5). For example, an important aspect of engaging in PBL includes the importance of learning from peers. However, our design failed to include any features that would support division of labor. If we evaluated our student persona and scenario through the lens of activity theory, we might have included features that supported collaborative learning and division of labor, including assigned tasks (e.g., information gathering), shared tasks, and artifact sharing. As it stood, students had to leverage other resources outside the learning environment to manage the division of labor, which could have presented challenges from a learning experience design perspective.

Consideration of our student persona through activity theory constructs identify other opportunities to improve the design. In this activity system, the community includes existing peer groups and classroom culture. The class was structured such that learners were assigned to groups near the beginning of class as they worked with their peers, which helped develop a smaller community among two to three peers. There was also the broader learning community of the business school, which emphasized portfolios and preparation for the business setting. If we had considered this as part of our persona and design, the learning technology could have included options to publish to their portfolio or possibly microcredentials/badges that reinforced the culture of the business school

Finally, activity theory also highlights the importance of rules. There are rules about university-wide initiatives (course conduct), but also rules on the course level rules related to due dates. We found that learners were especially mindful of the due dates for the final assignment, but this was not always easy to access and created unnecessary clicks to find this information within our initial design. There were additional rules about the assignment, such as the length and format, which required students to access. Other tangential rules applied, such as plagiarism, were not explicitly described within our learning environment.

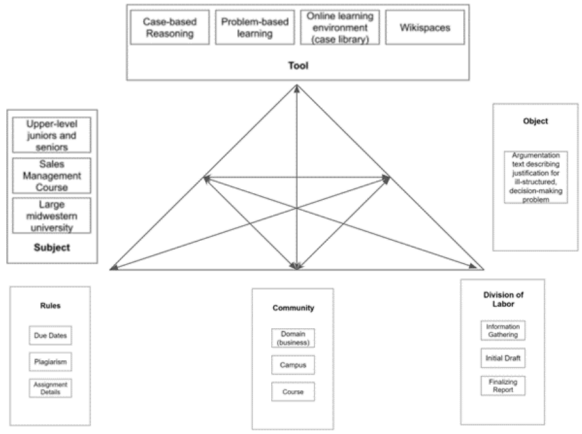
In this instance, a scenario using activity theory could be as follows:

> “On Monday, Javy opens up his assignment tab in his LMS and noticed a newly assigned task from his instructor. As he reads the description, he notices that he needs to work with his assigned classmates and submit a two-page argumentative essay. It seems as though there are more details when clicking on the link, which he does.
>
> The main page has narrative at the top and directions on the bottom, such as how long the essay is and when to turn things in. The narrative says two weeks, although he’s trying to line that up with the due date listed in the LMS. At the same time, he’s not quite clear about whether or not he has to cite sources like he did with his prior assignments and classes in the business school.
>
> As he opens the screen, he reads the main problem to solve as it details Sheila and Nick must make a decision about how to build their sales management team. Throughout the narrative he also notices hyperlinks at what seems to be important decision points such as considering prior experience, hiring from within, or considering alternate individuals from outside the company. It’s not totally clear, but it seems like the related cases are connected around these big ideas. By the time he’s read the fourth case, he’s frustrated because he’s constantly hopping back and forth across the different tabs.

After he reads the problem to solve and related cases, he meets with his other group members (Taylor and Jaren). Taylor offers to read the cases and make a bullet point summary for each one, while Jaren offers to look for some additional sources such as his textbook. It's a little unclear how they will share the resources at first, but eventually they decide to each upload a document to cloud storage and they will try to reconcile what has been learned across the various sources. Because this is an online course, they'll mostly share their ideas via the class discussion board. Once that is done, Javy offers to draft an initial version of the argumentation essay and then share it for his peers to view. Once they review, he double checks the assignment again as to whether one person needs to submit it or if each individually has to submit. Finally, he uploads an additional copy for the business portfolio that he needs to submit to the College of Business prior to graduation.

Figure 6

LXD of Nick's Dilemma learning environment through lens of activity theory



Activity theory diagram that has been annotated with specific details from the Nick's Dilemma case example

Whereas our initial design was focused on a learner (subject) employing the case library (tool) to submit an argumentative essay (objective), an activity theory-driven persona and scenario could have caused us to consider easy access of the assignment description to minimize unnecessary navigation. The interface could have also linked to additional rules, such as plagiarism and due dates, that were already established. In doing so, this would have allowed us to expand beyond a siloed understanding of the persona and thus allow the design team to better consider the overall learner experience.

Conclusion

As educators increasingly employ technology to support learning, there is a need to design and develop tools that effectively support the knowledge construction process. In many cases, theories that guide LX are rarely prescriptive and only recently emerging, therefore specific guidance for how they might be applied to design is lacking. While previous approaches may be content-driven (e.g., flipped classroom) or informed by theory (e.g., cognitive load), they may not consider the full extent of the learning experience design. Determining how to balance educational theory inspiration with the broader learner experience is ultimately left to the discretion of the learning designer. This is an area in which learning designers potentially can benefit from UXD methods and processes. Indeed, some learning designers have begun to adopt these methods. However, research suggests that learning designers tend to incorporate UXD methods and processes in ways that are incomplete and rudimentary. For example, learner personas might be developed, but then never referenced or used to inform design. UXD processes like wireframing or rapid prototyping might be employed, but without evaluating the designs with actual learners. Learning designs might be evaluated, but in simplistic ways such as quasi-expert review or other ad-hoc approaches. More robust processes are available, but are not often used.

One way to enhance the socio-technical design of learning environment is by espousing a human-computer interaction perspective, which allows us to not only consider what the s/he is learning, but the unique interactions that impact their learning process. HCI perspectives explicate methodologies and issues related to usability, but they also detail broader socio-cultural context of the user. To date, activity theory has been used to describe how individuals work together in many collaborative learning contexts. This theory further posits that individuals (subjects) seek out context-specific tools to achieve targeted tasks (object). However, the subject does not complete this task in isolation; rather, they different tools to complete the activity within their settings. Activity theory further outlines how s/he is connected to a social group as they complete said activity, which are often then used to divide responsibilities among the group members (division of labor) (Engeström, 2017; Sannino & Engeström, 2017). Finally, rules are the informal and formal regulations that govern the task and group dynamics (Yamagata-Lynch, 2010), which are used to describe the importance of social learning and peers scaffolding (MacLeod & van der Veen, 2020).

We argue that the constructs detailed in activity theory can address some of the challenges that designers face, especially as it relates to creating personas and the scenarios where learning takes place. Indeed, Gray (2016) cautioned that "even when designers believed in the value of personas, they did not use this perspective in their visible design processes. What this might suggest is some disjuncture between reported use of methods and the actual design activity" (p. 4045). The literature suggests problems arise because personas are often ill-defined (Chang et al., 2008), lack clarity (Holden et al., 2017), and used in ways not directly tied to design (T. Matthews et al., 2012). Using activity theory to construct scenarios for personas can help elucidate some of the contextual considerations of how a user engages in the learning process with technology. Activity theory applied to personas can develop scenarios that highlight the role of technology, but also the user's community, rules, and division of labor where the learning takes place. By detailing a more holistic context of the learner, design approaches that utilize activity theory can thus be used as a mechanism to identify limitations and improvements for digital learning environments. In doing so, designers can develop environments that better consider learner's dynamic interactions within their socio-cultural context.

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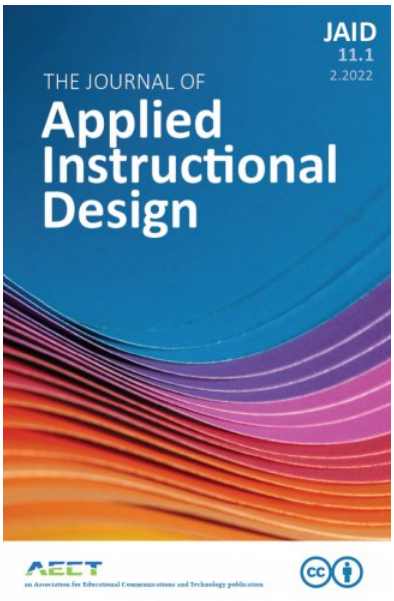

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