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The Utility of Design Thinking to Promote Systemic Instructional Design Practices in the Workplace

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Abstract

Designing within a system is ubiquitous to instructional design. In order to understand the systemic impact of design decisions within an organization, one must understand the interrelatedness of the objects within the system. Developing an understanding of context as it relates to the utility of instructional design solutions will position instructional designers to systemically influence the organization in a positive manner. This paper acknowledges the systemic challenges encountered by instructional designers in the workplace and discusses how design thinking can be leveraged with HPT strategies to assist the instructional designer with designing solutions that have a systemic impact on the organization. This paper also introduces a conceptual framework, grounded in general systems theory, that combines design thinking principles with instructional design practices to improve performance.

Keywords Systemic implications · General systems, instructional design · Design thinking

Regardless of the industry, instructional designers are expected to interact with a number of individuals and aspects of an organization when designing instruction. They may be responsible for working in design teams, developing training that will be used by individuals across multiple departments, and/or designing interventions to facilitate change in the workplace (Kenny et al. 2005; Koszalka et al. 2013; Sugar 2014). In order to accomplish these tasks most effectively, it is imperative that instructional designers understand how the individuals, processes, and infrastructure interact with one another. Failing do so often results in challenges encountered while implementing training and facilitating sustainable solutions.

While there are many definitions of instructional design used in the field (Branch and Merrill 2011; Merrill et al. 1996; Smith and Ragan 2005), Richey et al.'s (2011) definition explicitly calls attention to the science and art of the discipline: "Instructional design is the science and art of creating detailed specifications for the development, evaluation, and maintenance of situations which facilitate learning and improve performance" (p. 3). While the instructional design may comprise one unit or area within an organization, the long-term implications are widespread. Training has the potential to affect knowledge management, succession planning, customer relations, and strategic business operations. The implementation of good or poorly developed training in the workplace can pose systemic concerns to an organization (Brethower 2006; Pershing 2006). In order to effectively design solutions that facilitate learning and improve performance, instructional designers must have a solid grasp of the system that they design within (Stefaniak 2018).

While general systems theory is often credited as a foundational influence to the systematic nature of many instructional design models that are used (Branch and Dousay 2015; Churchman 1965; Hoban, Hoban Jr. 1977), the systemic nature and implications are often addressed in the human performance technology literature. Human performance technology (HPT) is defined as "the study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and systemic" (Pershing 2006, p. 6). The study of HPT complements the practice of instructional design by providing a lens to examine the system (i.e. organization) to facilitate learning and improve performance through the design and implementation of sustainable solutions (Foshay et al. 2014).

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Design thinking is a process that embodies empathetic design of solutions and iterations of ideation and innovation while engaging in problem-solving (Dorst 2011; Razzouk and Shute 2012). The notion of promoting an iterative approach to problem-solving aligns nicely with human performance technology and instructional design in that it takes into consideration the many layers and interactions that occur within a system (Brown and Wyatt 2010).

The purpose of this paper is to bridge the philosophy of design thinking and human performance technology with instructional design practices. This paper acknowledges the systemic challenges encountered by instructional designers in the workplace and discusses how design thinking can be leveraged with HPT strategies to assist the instructional designer with designing solutions that have a systemic impact on the organization. This paper also introduces a conceptual framework, grounded in general systems theory, that combines design thinking principles with instructional design practices to improve performance.

The Instructional Designer's System

Every project an instructional designer contributes to will involve a system. A system is "a set of objects together with relationships between the objects and between their attributes" (Hall and Fagen 1975, p. 52). An organizational system may include of a number of subsystems within the larger system. Within each subsystem exists persons, processes, and objects; many, if not all, interact with one another at some point in time.

Systems often include a set of interrelated components working together toward a goal, can be open or closed, receive inputs, and generates output (Churchman 1964; Miller 1978; von Bertalanffy 1972). Some systems may be closed or standalone where they are isolated from the environment and produce little interaction or open where interactivity exists between the system, additional systems, and the environment (Mizikaci 2006; von Bertalanffy 1968).

Utilizing a systems approach to improving performance implies "the idea of viewing a problem or situation in its entirety with all its ramifications, with all its interior interactions, with all its exterior connections and with full cognizance of its place in its context" (Mood 1964, p.1). To ensure alignment between design solutions and the system's needs, instructional designers "must take the holistic nature of the system and consider the effects on learning from all elements that exist within the system" (Author, 2018a).

To better understand the interaction within a system and how a system can adapt to adversity or change, Brethower (2006) describes six characteristics of the adaptive performance system:

- A system is a collection of elements and relationships, held together by a purpose in common.
- External relationships define the value added by the system.
- Internal relationships are essential in providing the value to be added.
- Maintaining two interconnected sets of relationships, internal relationships, and external relationships are necessary for survival.
- Systemic variables are interconnected.
- The actions required to maintain each set of relationships cannot be predicted in advance but must be guided by feedback (pp. 124–126).

Figure 1 provides an overview of what a system might look like for an instructional designer.

The Systemic Nature of Instructional Design Work: Expectations and Challenges

A challenge that individuals who are new to instructional design face are that instructional practices in instructional design graduate degree programs are typically taught in a scaled manner to meet the constraints of teaching within a semester-long course. Most instructional courses are focused on a specific facet of design (i.e. learning theory, fundamentals of instructional design processes, use of technological applications, program evaluation) that do not consider the systemic impact that design poses for organizations. Consequently, another challenge is that there is a large number of individuals working in instructional designer roles in industry and government organizations who have not received formal instructional design training; rather, they have learned on the job or through informal learning opportunities.

While instructional design practices are often taught as an iterative approach to designing solutions; it's recursive in practice (Tessmer and Wedman 1990). Instructional designers often find themselves interacting with clients, colleagues, and team members to refine their design solutions. Instructional designers would be more apt to account for organizational impact in their design work if they are able to look beyond the instructional design process and embrace a larger systems view of their respective projects (Foshay et al. 2014).

In order to understand the systemic impact of design decisions within an organization, one must understand the interrelatedness of the objects within the system. Brethower (2006) suggests that an adaptive system is one that can respond to changing circumstances. Table 1 provides some examples of negative and positive systemic implications that may result from instructional design decisions in a variety of contexts.

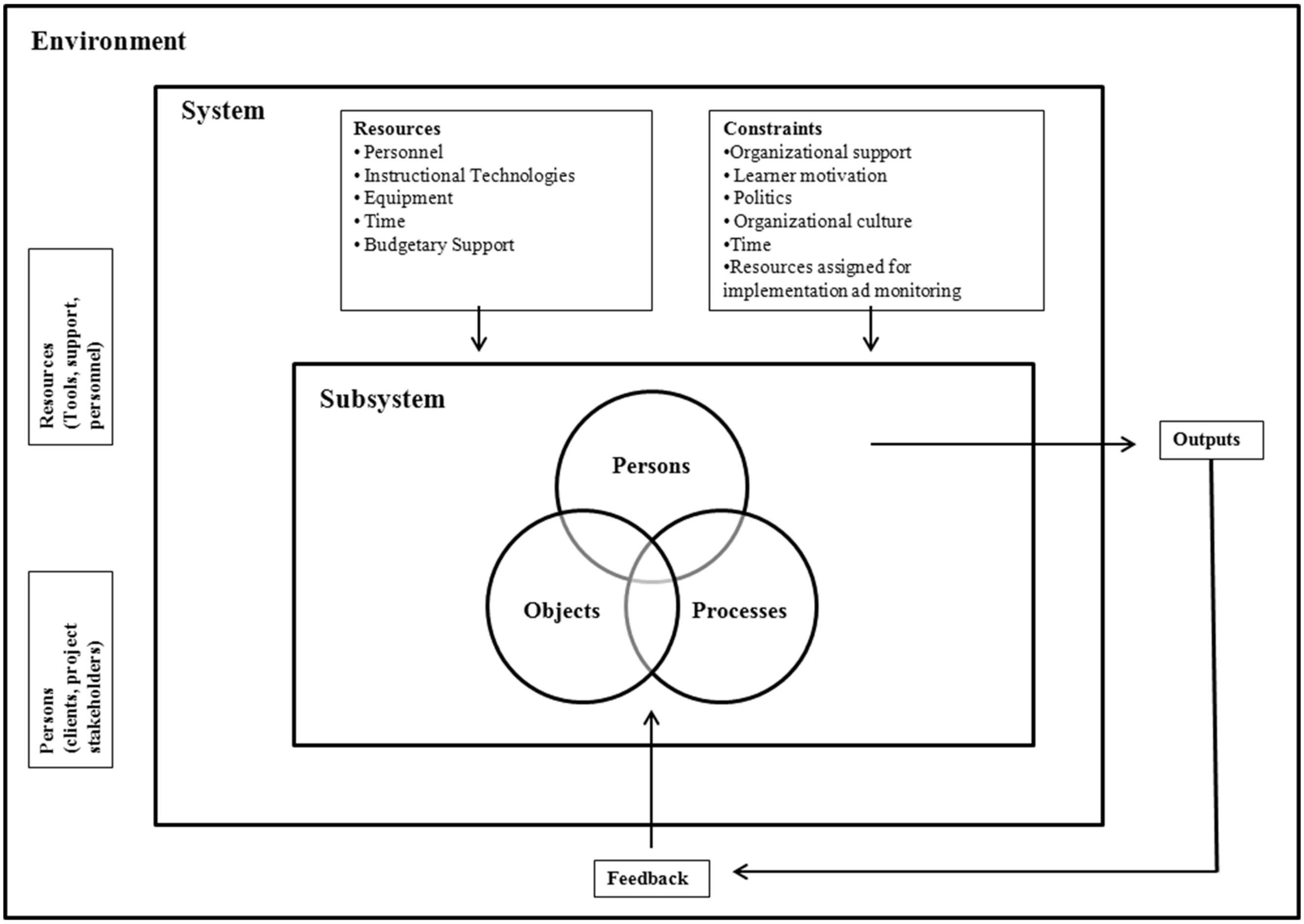

Fig. 1 A systems representation of an instructional designer's work as it relates to tasks and performance expectations

Leveraging Design Thinking to Understand the Role of Context in Systemic Instructional Design Practices

Developing an understanding of context as it relates to the utility of instructional design solutions will position instructional designers to systemically influence the organization in a positive manner. Context is ubiquitous in every instructional design situation. Instructional designers must be equipped to recognize and contend with the unique contextual factors that will ultimately affect their project outcomes. Tessmer and Richey (1997) explain that any and all instructional design solutions should account for orienting, delivery, and application contexts.

The orienting context occurs prior to the learning event and considers the factors that may influence the learner's ability to succeed during training. Attention is paid towards understanding learners' motivation in regard to learning the training content as well as the environmental support that is provided to the learners (Tessmer and Richey 1997). The instructional context "addresses factors that directly impact the delivery of instruction" (Richey et al. 2011, p. 64). Within this context, it is important that there is an understanding of the learners' and the instructor's roles. Additional attention is paid to the structure of the training materials and strategies used to deliver the instruction. Organizational factors influencing motivation such as rewards are also considered during the design process. The transfer context emphasizes the environment where the training is to be applied. Factors that should be addressed in this context include perceptions of the utility of transfer, perceived resources, social supports, and the organizational culture (Tessmer and Richey 1997). It is also important for strategies to be identified to assist individuals with their ability to transfer their knowledge successfully in the application setting.

The philosophy of design thinking promotes five phases (empathize, define, idea, prototype, and test) that should occur during problem-solving to transform critical needs into viable solutions (Brown and Wyatt 2010; Johansson-Sköldberg et al. 2013. The empathy phase requires one to really put themselves in someone else's position to better understand their needs and the problem(s) they are experiencing (Köppen and Meinel 2015; Roberts et al. 2016). The goal is to think deeply of those who will be impacted by solutions that are designed. Defining the problem is the second phase of design thinking. In this phase, an individual gathers sufficient data to truly understand the situation they are designing for (Kim and Ryu

Table 1 Examples of negative and positive system implications

Context	Negative systemic implications	Positive systemic implications
Healthcare	• Only training the nursing staff of a healthcare team. • Waiting for an incident to occur before developing training to address patient safety.	• Recognizing the need for interprofessional team training. • Developing instructional programs as a part of quality assurance. • Choosing to invest in the acquisition of new surgical equipment and providing professional development to healthcare professionals.
Government/Military	• Failing to train soldiers on conflict resolution. • Failing to provide adequate training on situational awareness in different contexts.	• Communicating the return on investment for training programs. • Training military personnel on ill-structured problem-solving skills they can apply in a variety of situations. • Ensuring military personnel is provided with sufficient training prior to deployment. • Conducting analyses to determine the need for revalidation of skills.
K-12	• Modifying curriculum without taking into consideration the impact changes may have for students with IEPs. • Adding curricular requirements without allocating sufficient time for students and teacher preparation. • Assuming students have the technological resources at home to complete homework assignments.	• Equipping schools with the necessary resources to support technologically-enhanced learning environments. • Providing the necessary assistive technology to support students. • Engage in curricular mapping to determine when (and to what extent) specific competencies are covered throughout a curriculum.
Business/Industry	• Designing instruction without conducting a needs assessment to verify the actual need or problem. • Providing instructional materials to a client when the instructional designer knows that it will not address long-term challenges.	• Conducting a needs assessment to validate the project need before commencing design work. • Developing a phased plan with employee buy-in for implementing a change in organizational practices.
Higher Education	• Encouraging programs to provide online courses without any faculty development. • Altering the structure of the delivery of a course or program to be more marketable to prospective students at the expense of quality. • Failing to provide the technological and budgetary support necessary to implement new educational initiatives.	• Providing faculty development support to assist with the delivery of instruction. • Developing a strategic plan that accounts for how an institution will accommodate an increase in online and campus-based students over a five-year span.

2014). It is important that they understand the problem or need to be addressed, the individuals impacted, and the contextual factors that may influence the success of a solution being implemented.

The phase of ideation calls for uninhibited brainstorming (Johnson 2005). Once a number of possible solutions are identified, they can then be scrutinized in terms of feasibility, cost, and practicality. As solutions are ranked and evaluated, the most viable solutions should emerge. The prototyping phase involves taking the most viable solution(s) from the previous phase and designing a prototype of that particular solution. Once a prototype has been designed, it should be tested and re-evaluated for effectiveness.

These phases are not meant to be followed systematically; rather, they are meant to be recursive with several iterations occurring before a viable solution is identified and launched (Brown and Wyatt 2010). Table 2 provides an overview of how instructional practices can align with design thinking to address contextual factors.

Heuristics to Support Systemic ID Practice

In order to implement design strategies that contribute to a systemic impact, the ID needs to understand the relationships between their organization (i.e. their system). Understanding the intricacies and relationships between the various elements of the system is not something that is achieved in a particular step of a linear systematic design model; it is an ongoing process. The role of ID is to continue surveying the environment and validating the design strategies to be used. The following are heuristics to assist IDs with aligning design strategies with organizational needs and contextual influences.

Utilize Performance Analysis Models to Understand Systemic Relationships Similar to needs assessment and analysis practices, performance analysis identifies and clarifies performance gaps by identifying the discrepancy between the desired state of performance and the actual state of performance. Performance analysis models are often used to assist practitioners with better understanding the multiple layers of an organization or system and the relationship between components in each of these layers.

IDs could greatly benefit from analyzing the performance within their organization as it relates to the design projects they have been assigned. There are a number of performance analysis models that can serve as a blueprint to assist the ID with better understanding the inputs and outputs of the system

Table 2 Alignment of instructional design practices with design thinking to address contextual factors

Design thinking phases	Instructional design practices	Supporting literature
Empathize	Learner analysis Persona development	Matthews et al. (2017) Parrish (2006) Rapanta and Cantoni (2013) van Rooij (2012)
Define the Problem	Needs assessment	Stefaniak et al. (2018)
Ideate	Brainstorming solutions Working with design teams Prioritizing needs	Tracey (2015) Valkenburg and Dorst (1998)
Prototype	Rapid prototyping	Jones et al. (1992) Jones and Richey (2000) Roytek (2010) Tripp and Bichelmeyer (1990)
Test	Usability testing Formative evaluation	Crowther et al. (2004) Kenny (2017) Lee (1999) Tessmer (1993)

and the interrelatedness between people, processes, and organizational infrastructure. Developing an understanding of the multiple layers within the organization will allow the ID to design more targeted interventions to address the actual needs. Table 3 provides an overview of the more commonly recognized performance analysis models, and a description of the model.

Validating the Identified Problem or Need Depending on the type of project, the instructional designer's role in needs assessment often varies. Sometimes they are consulted to conduct an extensive needs assessment prior to designing solutions for a problem or need that has been proposed by their client. Other times, they are informed of what the need is and asked to design solutions with no opportunity to conduct an actual needs assessment.

When the latter occurs, the instructional designer is often placed in a game of chance. They must assume that the client has conducted a needs assessment and has validated the actual need. It is one thing to identify a problem or need basing on an

Table 3 Performance analysis models

Performance analysis model	Description
Gilbert's (1978) Behavioral Engineering Model	A performance analysis tool that captures activity occurring within an organization at the performer (employee) and organizational levels. Resources are categorized according to information, instrumentation, and motivation to assess alignment between the skillset of the performer and the organizational infrastructure.
Rummler's Nine Variable Framework (Rummler 2006)	A performance analysis framework to assess performance goals, design strategies, and management across three levels of an organization or system (performer, process, and organizational). Similar to Gilbert's (1978) behavioral engineering model, the nine variable framework adds a third layer of assessment by parsing out processes to support the performer and organizational infrastructure.
Rothwell's (2005) Environmental Analysis Framework	An environmental analysis model that examines performance across four dimensions: the world (culture and society), workplace (organizational resources and tools), work (workflow, procedures, responsibilities), and workers (knowledge, skills, and attitudes).
Kaufman's (2000) Organizational Elements Model	This model, used in both needs assessment and performance analysis, differentiates between the means and ends associated with performance. The OEM model examines organizational performance according to organizational efforts (i.e. inputs and processes), organizational results (i.e. products and outputs), and societal impact (i.e. outcomes).

assumption or hunch; it is another to collect supporting data that explains why the problem is occurring and ensures that there is an actual need requiring a solution.

Instructional designers are supposed to be trained in needs assessment practices. This extends beyond conducting a learner analysis prior to the design of training. The ID should be responsible for verifying the actual needs of the project. This involves them engaging in dialogue with their client to explain the importance and need for gaining access to the necessary data to support the needs assessment process. Failing to do so will result in the ID potentially designing instructional or non-instructional solutions for a problem or need that does not exist, designing an intervention that does not address alignment between various aspects within the system (organization), and/or designing interventions that will be difficult to implement long-term and ensure a positive systemic impact.

Impose Design Constraints on the System Constraints are ubiquitous and powerful in every instructional design project; every ID must design solutions that accommodate design constraints unique to the situation. Rather than associating a negative connotation with the term *constraints*, IDs should view constraints as scaffolds to help narrow the scope of the system they are designing within.

As previously mentioned, systems can be viewed as open or closed. In order to adhere to the premise that the purpose of instructional design is to facilitate learning and improve performance, IDs should strive to design within open systems. This allows the ID to adhere to the characteristics identified by Mizikaci (2006) by promoting openness in the design space that receives feedback from the environment and produces outputs to achieve the system's goals.

When discussing the role that general systems theory poses for instructional design practices, Richey et al. (2011) purport that "it is the structure itself which dictates the function of the system" (p. 14). While Churchman (1964) proposes that a closed system is ideal in that isolation ensures ultimate stability, one could argue that this does not bode well for instructional design practices. Miller (1978) contends that survival is dependent on the system's ability to "interact and adjust to its environment" (p. 29).

A proponent of open systems, von Bertalanffy (1972) recognized that it was easy for an individual to find oneself in a mechanized routine system. To avoid this from occurring, von Bertalanffy proposed that we should view ourselves within systems through hierarchies that allow us to limit our vision for viewing the operations of a system. Relating this to design practices, we should promote the openness and interrelatedness of systems while imposing limitations on the extent of openness. These limitations, or boundaries, allow the design to narrow their focus on specific aspects of the system. Contextual factors and design constraints, identified while validating the project needs, allows the ID to avoid scope creep that can occur during design projects, direct the necessary attention to intricacies within the system, while still allowing for interaction and feedback among the objects of the system. While systematic in nature, the instructional design processes require the ID to be adaptive, flexible, and interactive within their design space and/or the organizational environment.

Employ Empathetic Strategies that Promote Recursive Design There has been a considerable increase in the attention given towards employing *empathetic design* practices in the field of instructional design (Crawford 2004; Matthews et al. 2017; Parrish 2006; Rapanta and Cantoni 2013; Rose and Tingley 2008). Considering the influence that design thinking has posed for instructional design practices, this aligns with the need for empathizing with the end-users or constituents in an organization (Koskinen and Battarbee 2003). In the case of instructional design, this often means emphasizing with the learners and individuals who will be impacted by our design interventions that are deployed (Kouprie and Visser 2009).

The greatest impact where we have seen empathetic design is focused on conducting the initial learner analysis and adopting a recursive approach to instructional design. Traditional learner analyses have typically focused on obtaining information related to learner demographics (i.e. gender, age, culture, pre-requisite skills). Cennamo and Kalk (2019) remind us to think of the learner as a person rather than a mere object moving through our instructional training sessions. By learning more about the person, IDs are better positioned to motivate these learners to acquire new skills, understand the relevance and need for these skills, and design strategies that address actual and perceived challenges the learner may face when attempting to apply these skills in the transfer context (Pulsinelli and Roubie 2001; van Rooij 2012).

Segal and Fulton Suri (1997) state that empathy is not only something to use during interactions with users, but it is also a way of thinking that should permeate throughout the design process" (p. 454). By keeping the learner at the focal point of an instructional design system, the ID can ensure alignment between the various aspects of the design process, the learner, and the identified and validated performance need and/or problem. Rather than being addressed at the beginning of an instructional design project or within the first step of a systematic ID model, the ID continues to revisit the learner analysis through every phase of the design process and makes the necessary revisions to his or her intervention.

A Conceptual Framework for Systemic Instructional Design Activity

While there are a number of instructional design and performance analysis models, it can be argued that systemic boundaries and implications are missing. Figure 2 presents an overview of how an instructional designer may plan out their instructional design activities to consider systemic impact while promoting a design thinking philosophy. This framework is not meant to replace or compete against any existing model; rather, it is meant to serve as a blueprint for assessing how design activity is addressing systemic impact in any instructional design setting.

The design system or space that the ID operates within is open allowing for feedback between the inputs, design activities, and the instructional designer. The inputs (i.e. resources, design personnel, project constituents, orienting, instructional and transfer contextual variables) allow the ID to bind the system and operate with a focus on the design constraints inherent to the design situation.

The learner and performance need are two variables that remain present throughout all design activity. The performance need should be revisited continuing through the identification of the need, validation of the need, alignment of design practices, products, and outputs, and evaluating the impact of outputs at the performer, process, and organizational levels of a system. The learner is positioned as a focal point throughout the design process. As the ID progresses through their design plan, they are employing recursive design practices to continually assess how each design activity will support or inhibit the learner. This further supports Segal and Fulton Suri's (1997) position that empathy should permeate throughout the design process.

Conclusion

Instructional design work has systemic implications whether the ID acknowledges them (or is aware of them) during the design process. While our field has done an excellent job at teaching aspiring IDs the systematic approach to instructional design, IDs could greatly benefit from additional pedagogy emphasizing general systems theory and the implications that their role, as the designer, poses for the system. Additional research is needed to explore pedagogical approaches focused on *how* we mentor and train instructional designers to understand how to operate and interact with their systems, as well as the implications this poses for instructional design research. Reeves and Reeves (2015) questioned the overarching research goals of our field: are we conducting instructional design research that is guided

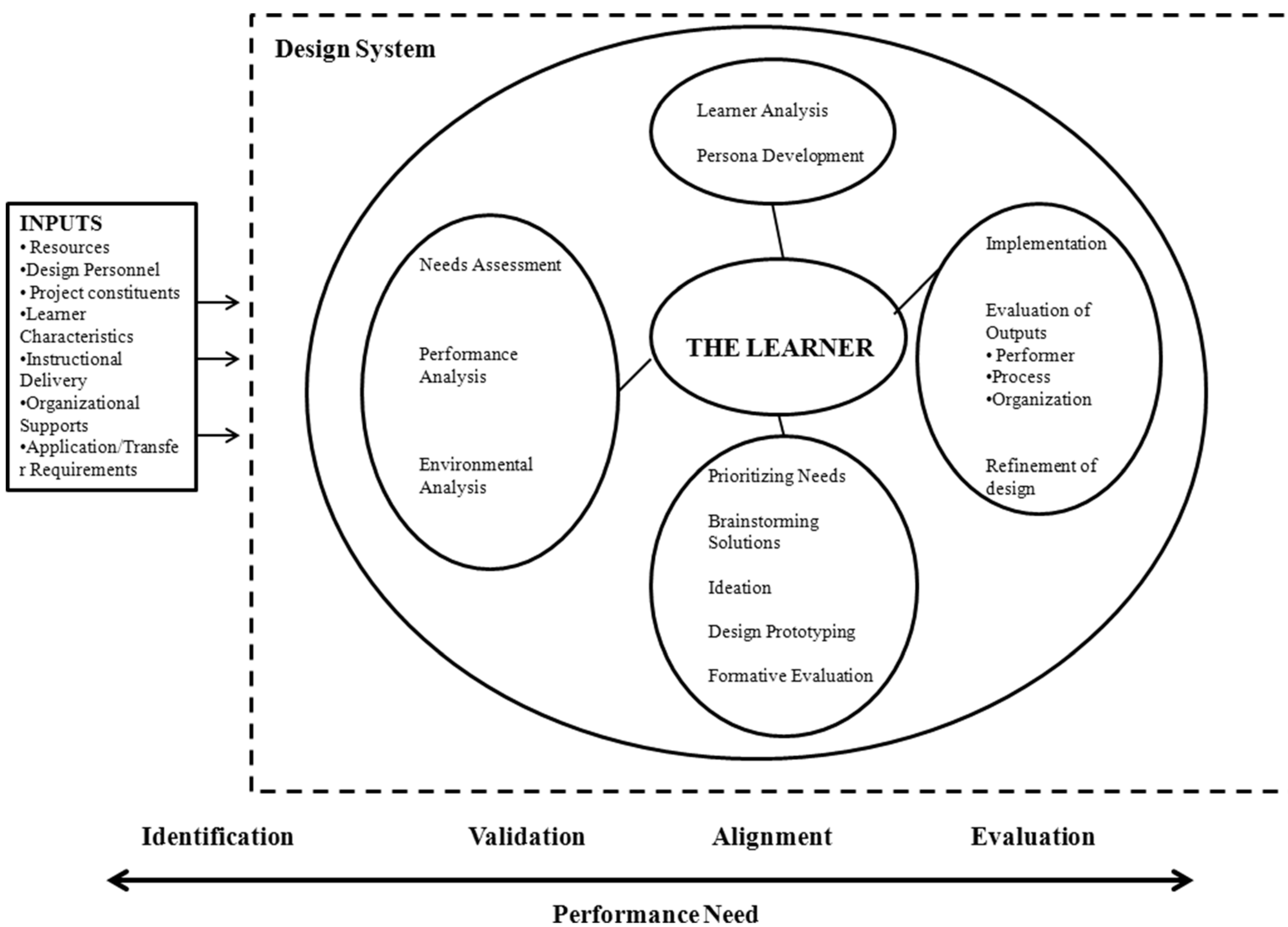

Fig. 2 A conceptual framework for systemic instructional design activity

by the need to solve particular societal problems or are instructional strategies guiding the research and any societal benefits are a bonus? By understanding the systemic impact of instructional design, the system, and the ID's responsibility of imposing boundaries within the system, our practitioners and researchers have an opportunity to contribute to longlasting sustainable solutions and research innovations.

Compliance with Ethical Standards

Conflict of Interest The author declares that she has no conflict of interest.

References

Branch, R., & Dousay, T. (2015). *Survey of instructional design models, 5th ed*. Bloomington, Indiana: Association for Educational Communications and Technology.

Branch, R., & Merrill, M. D. (2011). Characteristics of instructional design models. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology (3rd ed.)*. Upper Saddle River: Merrill-Prentice Hall.

Brethower, D. M. (2006). Systemic issues. In J. A. Pershing (Ed.), *Handbook of human performance technology 3rd ed.* (pp. 111–137). San Francisco: Pfeiffer.

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. *Development Outreach, 12*(1), 29–43.

Cennamo, K., & Kalk, D. (2019). *Real world instructional design (2nd ed.)*. New York: Routledge.

Churchman, C. W. (1964). An approach to general systems theory. In M. C. Mesarovic (Ed.), *Views on general systems theory: Proceedings of the second systems symposium at case institute technology* (pp. 173–175). New York: John Wiley & Sons, Inc..

Churchman, C. W. (1965). On the design of educational systems. *Audiovisual Instruction, 10*(5), 361–365.

Crawford, C. (2004). Non-linear instructional design model: Eternal, synergistic design and development. *British Journal of Educational Technology, 35*(4), 413–420.

Crowther, M. S., Keller, C. C., & Waddoups, G. L. (2004). Improving the quality and effectiveness of computer-mediated instruction through usability evaluations. *British Journal of Educational Technology, 35*(3), 289–303.

Dorst, K. (2011). The core of 'design thinking' and its application. *Design Studies, 32*(6), 521–532.

Foshay, W. R., Villachica, S. W., & Stepich, D. A. (2014). Cousins but not twins: Instructional design and human performance technology in the workplace. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology 4th ed* (pp. 39–49). New York: Springer.

Gilbert, T. F. (1978). *Human competence: Engineering worthy performance*. New York: McGraw-Hill.

Hall, A. D., & Fagen, R. E. (1975). Definition of system. In B. D. Ruben & J. Y. Kin (Eds.), *General systems theory and human communications* (pp. 52–65). Rochelle Park: Hayden Book Company, Inc..

Hoban Jr., C. F. (1977). A systems approach to audiovisual communications. In L. W. Cochran (Ed.), *Okoboji: A 20-year review of leadership 1955–1974* (pp. 67–72). Dubuque: Kendall/Hunt.

Johansson-Sköldberg, U., Woodilla, J., & Çetinkaya, M. (2013). Design thinking: Past, present and possible futures. *Creativity and Innovation Management, 22*(2), 121–146.

Johnson, B. (2005). Design ideation: The conceptual sketch in the digital age. *Design Studies, 26*(6), 613–624.

Jones, T. S., & Richey, R. C. (2000). Rapid prototyping methodology in action: A developmental study. *Educational Technology Research and Development, 48*(2), 63–80.

Jones, M. K., Li, Z., & Merrill, M. D. (1992). Rapid prototyping in automated instructional design. *Educational Technology Research and Development, 40*(4), 95–100.

Kaufman, R. (2000). *Mega planning: Practical tools for organizational success*. Thousand Oaks: Sage Publications.

Kenny, R. J. (2017). Introducing journal of formative Design in Learning. *Journal of Formative Design in Learning, 1*(1), 1–2.

Kenny, R., Zhang, Z., Schwier, R., & Campbell, K. (2005). A review of what instructional designers do: Questions answered and questions not asked. *Canadian Journal of Learning and Technology/La revue canadienne de l'apprentissage et de la technologie, 31*(1).

Kim, J., & Ryu, H. (2014). A design thinking rationality framework: Framing and solving design problems in early concept generation. *Human-Computer Interaction, 29*(5–6), 516–553.

Köppen, E., & Meinel, C. (2015). Empathy via design thinking: Creation of sense and knowledge. In H. Plattner, C. Meinel, & L. Leifer (Eds.), *Design thinking research: Building innovators* (pp. 15–28). New York: Springer.

Koskinen, I., & Battarbee, K. (2003). Introduction to user experience and empathic design. In I. Koskinen, K. Battarbee, & T. Mattelmäki (Eds.), *Empathic design* (pp. 37–50). Hel: IT Press.

Koszalka, T. A., Russ-Eft, D. F., & Reiser, R. (2013). *Instructional designer competencies: The standards (4th Ed.)*. Charlotte: Information Age Publishing.

Kouprie, M., & Visser, F. S. (2009). A framework for empathy in design: Stepping into and out of the user's life. *Journal of Engineering Design, 20*(5), 437–448.

Lee, S. H. (1999). Usability testing for developing effective interactive multimedia software: Concepts, dimensions, and procedures. *Journal of Educational Technology & Society, 2*(2).

Matthews, M. T., Williams, G. S., Yanchar, S. C., & McDonald, J. K. (2017). Empathy in distance learning design practice. *TechTrends, 61*(5), 486–493.

Merrill, M. D., Drake, L., Lacy, M. J., & Pratt, J. (1996). Reclaiming instructional design. *Educational Technology, 36*(5), 5–7.

Miller, J. G. (1978). *Living systems*. New York: McGraw Hill.

Mizikaci, F. (2006). A systems approach to program evaluation model for quality in higher education. *Quality Assurance in Education, 14*(1), 37–53.

Mood, A. (1964). *Some problems inherent in the development of a systems approach to instruction. Paper presented at conference on new dimensions for research in educational media implied by the systems approach to education*. Syracuse: Syracuse University.

Parrish, P. (2006). Design as storytelling. *TechTrends, 50*(4), 72–82.

Pershing, J. A. (2006). Human performance technology fundamentals. In J. A. Pershing (Ed.), *Handbook of human performance technology* (3rd ed., pp. 5–26). San Francisco: Pfeiffer.

Pulsinelli, A., & Roubie, C. (2001). Using diversity modeling for instructional design. *Performance Improvement, 40*(7), 20–27.

Rapanta, C., & Cantoni, L. (2013). Being in the users' shoes: Anticipating experience while designing online courses. *British Journal of Educational Technology, 45*(5), 765–777.

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of Educational Research, 82*(30), 330–348.

Reeves, T. C., & Reeves, P. M. (2015). Educational technology research in a VUCA world. *Educational Technology, 55*(2), 26–30.

Richey, R. C., Klein, J. D., & Tracey, M. W. (2011). *The instructional design knowledge base: Theory, research, and practice*. New York: Routledge.

Roberts, J. P., Fisher, T. R., Trowbridge, M. J., & Bent, C. (2016). A design thinking framework for healthcare management and innovation. *Healthcare, 4*(1), 11–14.

Rose, E., & Tingley, K. (2008). Science and math teachers as instructional designers: Linking ID to the ethic of caring. *Canadian Journal of Learning and Technology, 34*(1).

Rothwell, W. (2005). *Beyond training and development: The groundbreaking classic on human performance enhancement (2nd ed.)*. New York: Amacom.

Roytek, M. A. (2010). Enhancing instructional design efficiency: Methodologies employed by instructional designers. *British Journal of Educational Technology, 41*(2), 170–180.

Rummler, G. A. (2006). The anatomy of performance: A framework for consultants. In J. A. Pershing (Ed.), *Handbook of human performance technology 3rd ed.* (pp. 986–1007). San Francisco: Pfeiffer.

Segal, L. D., & Fulton Suri, J. (1997). The empathic practitioner: Measurement and interpretation of user experience. Proceedings of the human factors and ergonomics society 41st annual meeting, Albuquerque, NM.

Smith, P. L., & Ragan, T. J. (2005). *Instructional design (Third ed.)*. Hoboken: John Wiley & Sons, Inc..

Stefaniak, J. (2018). Performance technology. In R. E. West (ed.), Foundations of learning and instructional design technology: The past, present, and future of learning and instructional design technology. EdTechBooks.org. Retrieved from http://edtechbooks.org/lidtfoundations/performance_technology

Stefaniak, J., Baaki, J., Hoard, B., Stapleton, L. (2018). The influence of perceived constraints during needs assessment on design conjecture. *Journal of Computing in Higher Education, 30*(1), 55–71.

Sugar, W. (2014). *Studies of ID practices: A review and synthesis of research on ID current practices*. London: Springer.

Tessmer, M. (1993). *Planning and conducting formative evaluations*. New York: Kogan Page Limited.

Tessmer, M., & Richey, R. C. (1997). The role of context in learning and instructional design. *Educational Technology Research and Development, 45*(2), 85–115.

Tessmer, M., & Wedman, J. F. (1990). A layers-of-necessity instructional development model. *Educational Technology Research and Development, 38*(2), 77–85.

Tracey, M. W. (2015). Design team collaboration with a complex design problem. In B. Hokanson, G. Clinton, & M. W. Tracey (Eds.), *The design of learning experience* (pp. 93–108). New York: Springer.

Tripp, S., & Bichelmeyer, B. (1990). Rapid prototyping: An alternative instructional design strategy. *Educational Technology Research & Development, 38*(1), 31–44.

Valkenburg, R., & Dorst, K. (1998). The reflective practice of design teams. *Design Studies, 19*(3), 249–271.

van Rooij, S. W. (2012). Based personas: Teaching empathy in professional education. *Journal of Effective Teaching, 12*(3), 77–86.

von Bertalanffy, L. (1968). *General system theory* (Vol. 1). New York: Braziller.

von Bertalanffy, L. (1972). The history and status of general systems theory. *The Academy of Management Journal, 15*(4), 407–426.