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Design Thinking Pedagogy: Tools and Strategies for Engaged Learning

ABSTRACT

Faculty and students have diversified and refined design thinking over recent decades, and more institutions are using it in the development of transformative learning experiences. The first of its kind, this study examines the potential outcomes of design thinking educational workshops, through which students learn and practice design thinking methods. Tailored for the promotion of each course's learning objectives, these sessions cover a diverse range of topics and skills. We build upon existing research, backed by over two decades of design thinking literature and five years of data from a university center for design thinking, to share teaching strategies and classroom practices that foster engaged learning. Through a mixed-methods design, this article explores data collected through five years of short-form design thinking "workshop" sessions. We sourced this data from 971 sessions and represents 7,400 individuals' responses for a short survey provided at the end of each session. Findings are compared to research on high impact learning practices for supporting engaged learning environments. Comparative analysis shows that design thinking learning strategies consistently fostered engaged learning environments. From this comparative analysis, we analyzed the various design thinking learning strategies that participants felt were most valuable. Beyond the analysis, this paper will also present the most highly valued pedagogical tools used in these sessions for readers interested in implementing them in a classroom setting.

KEYWORDS

design thinking, engaged learning, educational workshops

INTRODUCTION

Emerging from the intersection of design, engineering, and the wicked problems tradition, design thinking (DT) is an active learning and collaborative problem-solving process that brings together strategies from various fields. As a pedagogical approach, DT provides a framework and set of methods for encouraging faculty and students to inclusively explore diverse values and needs when examining complex issues and potential solutions. As faculty and students have diversified and refined DT pedagogies over recent decades, the value of supporting engaged learning practices has become more apparent (McLaughlin, Chen, Lake, Guo, Skywark, Chernik, Liu 2022; Royalty and Roth 2016; Waity, Sellon, and Williams 2023). However, limitations with data collection make it difficult to understand the role of DT for fostering engaged learning environments. Furthermore, institutional frameworks and course requirements often limit an instructors' ability to integrate DT learning strategies. As such, this paper evaluates an increasingly attractive option: sequenced DT learning

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strategies that allow faculty to take advantage of the pedagogical benefits of DT in order to meet programmatic and course-specific objectives.

The first of its kind, this study uses cross-sectional data to examine the outcomes and benefits of DT educational workshops. These sessions are offered through the Center for Design Thinking at Elon University. The center's mission is to develop, teach, and study effective DT strategies. With this mission in mind, the center oversaw a number of cross-institutional research studies and facilitated over 900 sessions, reaching over 20,000 participants between 2019 and 2024. Tailored for the promotion of each course's learning objectives, these sessions cover a diverse range of topics and skills (e.g., coping with failure, prototyping, brainstorming, etc.). Through a mixed-methods research design, this article evaluates both quantitative and qualitative data collected through a survey provided to participants at the end of each session. This paper analyzes findings through the lens of Moore's (2023) key engaged learning practices to understand the pedagogical value of DT. Beyond measuring value, we used the data to determine which specific strategies students found to be most valuable and how they aligned with key practices.

This comparative analysis shows that implementing DT practices into course sessions consistently fosters an engaged learning environment for most-to-all participants, thus highlighting that DT methods are valuable for facilitating effective and engaging classroom experiences.

LITERATURE REVIEW

Design thinking: Pedagogical tools for skill building

Applied research on the scholarship of teaching and learning (SoTL) within DT has historically contemplated how specific methods and tools lead to particular educational outcomes (Lor 2017; Luka 2019; McLaughlin, Lake, Chen, Guo, Knock, and Knotek 2023; Panke 2019; Royalty et al. 2016). Several studies have investigated the various elements of DT pedagogies, and how they support particular learning outcomes. For instance, Lor (2017) and Panke (2019) document that a particularly effective way learners build on existing knowledge is by generating new ideas through real-life situations, a common element of DT processes. As such, students are pushed to go far beyond the simple facts and details of a topic in order to establish a rationale for their response (Crawford, Saul, Mathews, and Makinster 2005), which further emphasizes the importance of advancing cognitive development. In doing so, learners take ownership of their learning experiences and determine outcomes for themselves, encouraging them to take risks and try different approaches in order to reach viable solutions.

Beyond its concrete pedagogical applications, the DT process supports many hard and soft skills that go beyond engaged learning (McLaughlin et al. 2023). In contrast to many traditional college classroom settings, DT requires a flexible classroom structure, more accurately representing real-world problem-solving. It also encourages a focus on others' experiences and goals, prompting the integration of storytelling, empathetic observation, and collaboration. These elements enable learners to think critically about the relationship between insights, to identify patterns that they wouldn't typically recognize, and to develop more comprehensive solutions for testing and feedback (Luka 2019; McLaughlin et al. 2023; Royalty et al. 2016).

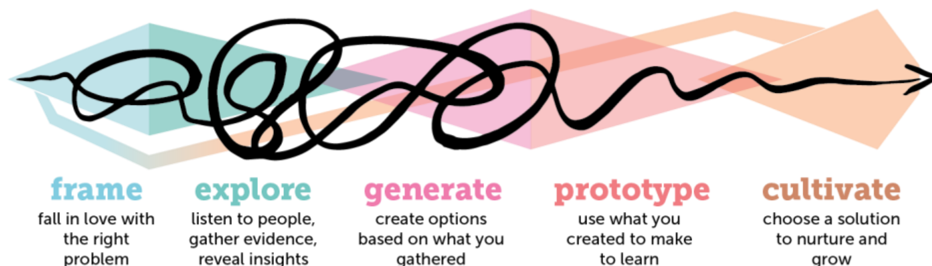
Across disciplines, scholars have framed DT as a valuable method for identifying problems, incorporating human experiences into effective sensemaking, and creating novel solutions (Lake, Guo, Chen, and McLaughlin 2024; McLaughlin et al. 2022). DT often targets undefined, novel, or wicked problems, exposing learners to methods for problem-solving that can help meet and extend curricular learning goals. As a pedagogy, DT may also cultivate cognitive, affective, and action-oriented empathy (Jamal, Kircher, and Donaldson 2021).

While different DT approaches use a variety of terms (i.e., sensemaking, perspective-taking, immersion, framing, generating, etc.), they tend to implement similar strategies. Most DT processes encourage their users to incorporate the diverse perspectives of others and refine their perspectives into problem statements (Rauth, Köppen, Jobst, and Meinel 2010). Following this more inclusive framing, learners utilize a variety of methods to imagine, design, and implement new solutions, from ideating (i.e., brainstorming), to prototyping[1] and testing (James and Shehab 2024). When paired with integrated practices for problem-based learning, DT pedagogies enable learners to connect more deeply with both subject matter and the real-world impact of the material (Shehab 2019; Waity et al. 2023). Over the past 25 years, researchers have accumulated a considerable amount of evidence that DT pedagogies provide strong support for engaged learning practices (Lor 2017; Micheli, Wilner, Bhatti, Mura, and Beverland 2019; Panke 2019; Royalty et al. 2016; Waity et al. 2023).

A visual framework

The Center for Design Thinking at Elon University has its own flexible framework for supporting learners through the DT process (evident in Figure 1). This process is similar to frameworks used by other prominent DT practitioners (Stanford's d.school, IDEO, etc.). Differences in the center's model largely result from the center's commitment to address wicked problems via self-reflexivity, systems-level thinking[2], and equity-centered design: a willingness to value pragmatic outcomes, and a focus on the cultivation of skills (Akama, Light, and Agid 2023; Costanza-Chock 2020; Lake, Lehman, and Chamberlain 2019). This focus on skills and virtues for life design largely results from working with the populations that the center serves (university students, faculty, community organizations, local businesses, and other higher education institutions), which differs from other prominent historic models that often have a larger focus on yielding innovative physical products or services (e.g., IDEO, IBM, etc.). Since we used this heuristic throughout the learning sessions analyzed in this article, each stage is briefly summarized below.

Figure 1. Center for Design Thinking Process Heuristic



Frame

Wicked problems and systems-thinking research show that any effective problem-solving process must begin by understanding each person's motivations—including their positionality, social identities, and experiences (Vink 2022; Vink, Edvardsson, Wetter-Edman, and Tronvoll 2019); therefore, framing is the first step of this process. Framing prompts participants to become aware of how they approach situations and to consider what motivates them to act. In this stage, learners are encouraged to revisit their prior knowledge and experiences to fully consider their interactions with others. This allows individuals to reflect on themselves (McLaughlin et al. 2023) in order to understand how their various identities and worldviews impact how they approach a situation and define the problem. Oftentimes, this process of externalizing identities allows learners to consider their

positionality in design, leading to a more equitable, relational design process (Noel, Ruiz, van Amstel, Udoewa, Verma, Botchway, Lodaya, and Agrawal 2023; Udoewa 2022).

Explore

After framing, learners next leverage and challenge their previous knowledge through the explore stage. Exploring encourages learning that moves beyond the academic, asking participants to explore the context of their communities more broadly. In this stage, learners have opportunities to observe critically, deeply listen, and empathize, prompting the expansion of their frameworks prior to generating solutions (Elon Center for Design Thinking 2018; IDEO n.d.; Wurdinger and Qureshi 2014). Within the classroom, students can leverage each other's experiences from beyond the space, learning from their larger communities. In practice, learners are paired with real stakeholders and situations, allowing them to gain mutually beneficial understandings of complex situations (Beligatamulla, Rieger, Franz, and Strickfaden 2019; Panke 2019; Udoewa and Gress 2023). The long-term goal is to foster a more participatory, situated, and emergent approach toward collectively addressing real-world issues (Lake, Motley, and Moner. 2023). This stage can cultivate active listening, trust, and "action-oriented empathy" (Lake, Marshall, Carducci, and Thurnes 2022; McLaughlin et al. 2022). This holistic approach toward learning may also engage learners in their real-world contexts and foster relationships (James et al. 2024; Lake et al. 2024; Waity et al. 2023).

Generate

Once learners have thoroughly explored the problem, they move on to the generate stage, which encourages rapid idea formation. Generating prompts both "near" and "far" transfer of knowledge, requiring participants to integrate information from within and outside the workshop into the ideation process (Lor 2017; Moore 2023). In some studies, the generate stage of the process has helped cultivate emergent, flexible habits (Lor 2017; Panke 2019). As Lake et al. (2024) notes, generating encourages "growth in students' willingness and ability to engage in emergent thinking, replacing habits of latching onto a 'first, best answer'" (10).

Prototype

The prototyping stage reinforces the notion that individuals learn through hands-on experiences. In this stage, learners create mock-ups with varying degrees of effort and resources in order to test the value and viability of their ideas. There are many ways that prototypes can emerge, including quick sketches, physical mock-ups, roleplaying scenarios, and engineered robots. The goal is to reduce the risks and resources needed to learn and to prompt opportunities for receiving iterative feedback (Lake et al. 2024; Lor 2017), thus fostering a more engaged learning environment (Panke 2019; Udoewa 2022). As a result, prototyping motivates developmental mindsets, collaboration, and open communication; it can create a space of critical reflection and transformation valuable for the actual project, the learning process, and oneself (James et al. 2024; Lauff 2022; Moore 2023).

Cultivate

The cultivate stage prompts both next-step actions and reflection on the long-term learning-action journey. The former requires learners to consider the results of their generating and prototyping stages, choose a solution, and make plans to implement it. The latter involves reflecting upon the learning-making process in order to extract strategies for future problem-solving experiences (Lor 2017). Unlike other steps of the DT process, where much of the reflection serves a self-contained purpose, cultivating is when the learning is intentionally "transferred" into the world

outside the physical class (Panke 2019, 290). Full-scale implementation prompts learners to test out their ideas and consider potential improvements.

While the visual heuristic above linearly portrays these steps, the squiggly line running through the visual indicates that this action-oriented learning journey is non-linear. As learners iterate, they not only design solutions more likely to yield valuable outcomes; they also cultivate skills and mindsets that foster creative confidence (Liedtka, Hold, and Eldridge 2021; Lor 2017; Rauth et al. 2010).

Key engaged learning practices: What we know

The 2023 *Key Practices for Fostering Engaged Learning: A Guide for Faculty and Staff*, consolidates SoTL to highlight six key practices for supporting engaged learning: acknowledging and building on prior knowledge, facilitating relationships, offering feedback, framing connections to broader contexts, fostering reflection on learning and self, and promoting information and the transfer of knowledge and skills (Moore 2023). The book argues that through these six practices, faculty can create highly effective, engaging learning experiences in and beyond the classroom.

The first practice that Moore emphasizes as essential is acknowledging and building on prior knowledge. Kuh and O'Donnell (2013) and Lor (2017) showed that prior knowledge and experience play a fundamental role in shaping thought processes and constructing new knowledge for life-long learning. Others showed that accessing that knowledge in the classroom leads to more effective learning outcomes (James et al. 2024). Building on previous knowledge and experiences enables students to shift their focus to newer and more complex topics (Ambrose, Bridges, DiPietro, Lovett, and Norman 2010; National Academies of Sciences, Engineering, and Medicine 2019). Teaching strategies centered around learners sharing prior knowledge create an awareness of diverse information offered by the community.

Facilitating relationships is essential for cultivating a sense of belonging and encouraging a positive outlook toward constructive feedback, both of which are prerequisites for transformational learning (Moore 2023). Studies have consistently demonstrated that intentional and consistent effort focused on cultivating relationships strengthens feedback cultures and supports "lifelong and lifewide learning" (Moore 2023, 30). This is present in authentic mentoring relationships, which foster meaningful connections that contribute to both the academic and personal growth (Felten, Gardner, Schroeder, Lambert, and Barefoot 2016; Felten and Lambert 2020).

The third practice, offering feedback, advances learners' understanding and application of course concepts (Moore 2023). Moore notes that constructive feedback should include input from peers, faculty, communities beyond the classroom, and the students themselves. The main goal of offering feedback is to teach students how to be self-regulated learners and how to take advantage of the criticism given to them (Nicol and Macfarlane-Dick 2006). Studies suggest that several conditions must be present for the feedback to be effective, including clear goals, a belief that the feedback is credible and useful, and a learning culture that facilitates the feedback loops.

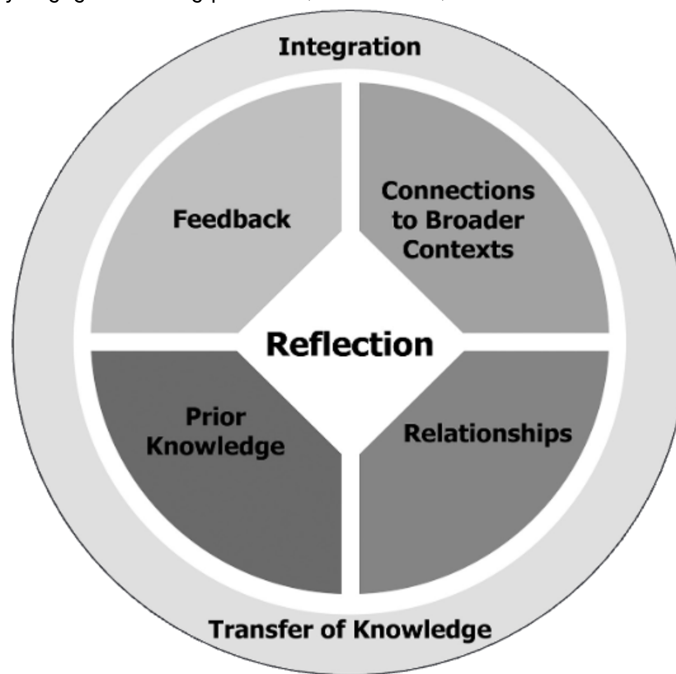
By framing connections to broader contexts, faculty can support student efforts to put theory into practice as they navigate complex problems (Moore 2023). Examples include project-, problem-, case-, and community-based learning. Such experiences engage students with real world scenarios, problems, and/or stakeholders; they often provide hands-on opportunities to negotiate uncertainties and apply course content. This enables educators to consider how they might further improve their curriculum so it better prepares students for the real-world (Budwig and Jessen-Marshall 2018).

Reflection on learning and oneself allows students to hone reflective strategies that support the active integration and transfer of learning (Moore 2023). One such strategy, metacognitive

reflection, enables students to actively monitor and regulate their cognitive and emotional processes (Ambrose et al. 2010; National Academies of Sciences, Engineering, and Medicine 2019). This allows them to alter their learning behaviors to better achieve their goals (Moore 2023). Reflection plays a central role in engaged learning, because it integrates and relies on other key practices, facilitating the transfer and application of knowledge across various contexts.

The last practice, promoting integration and transfer of knowledge, is dependent on crossing boundaries, building on prior knowledge, and creating connections to accomplish a goal. Moore defines transfer as "an individual's ability to repurpose or transform prior knowledge for a new purpose and context" (98). This allows students to apply past experiences to a different context. For students to effectively transfer and integrate knowledge, they must have opportunities to draw from their prior learning and experiences (Bransford, Brown, and Cocking 2000).

Figure 2. Diagram of the key engaged learning practices (Moore 2023)



METHODS AND PRESENTATION OF DATA

Research design

Using prior literature from diverse fields as a basis, this project operates under the hypothesis that the DT learning process and many of its most prominent methods catalyze the six engaged learning practices. While prior studies suggest this, they have not yet made this connection explicit. Thus, this study examines whether the process and methods of DT foster an engaged learning environment.

Due to the logistical hurdles of collecting and analyzing data across multiple contexts over the long-term, we set up this initial study to collect participant's responses immediately at the conclusion of each session through a short Qualtrics survey. In the spirit of DT, the original assessment goals driving this research project were to understand and enhance the value of each DT educational session from the participant's perspective in real-time and share longer term insights with the larger community. That is, we designed the study to collect immediate, low stakes, anonymous feedback to

support actionable opportunities for revision while providing a venue to share potential generalizable insights with educators.

After scanning a QR code, participants could read a consent script that explained the risks and benefits of opting in, as well as their rights as research participants. We stored the data within Qualtrics's cloud and analyzed it with Microsoft Excel. The research team included members of the workshop facilitation team, and therefore, we segmented the facilitator data prior to analysis.

DT sessions primarily took place at a mid-sized, private institution in the southeastern United States. While students made up the majority of the survey participants, the list also included faculty, staff, community members, as well as students and faculty at other universities. We collected results from 2019–2024, during which facilitators conducted a total of 971 DT sessions, engaging approximately 20,305 participants. 114 facilitators conducted these sessions, which covered a range of 15 pre-set topics, as well as customized workshops. Of these 971 sessions, 69% were directed towards undergraduate students, 17% for graduate students, faculty, and staff, and 13% were directed toward community and consulting partners. Sessions for undergraduate students had a maximum attendance of 33 participants, with an average of around 30. The sessions for community partners beyond the university oftentimes had over 100 participants. Therefore, while the percentages presented above are representative of the sessions analyzed, they may not be representative of the full participant pool. The survey did not collect demographic data, and thus it is not possible to elaborate further on the sample's characteristics; however, the sample is assumed to be fairly representative of the entire population. With an initial total of 8,995 survey responses, this analysis uses the 7,400 remaining after the exclusion of incomplete responses. This represents 35% of total session participants.

The survey included four quantitative and three qualitative open-ended prompts. The four quantitative questions asked participants to rate their experience on a seven point scale (with one representing strongly disagree and seven representing strongly agree) about whether the session: (1) enhanced their interests in DT practices, (2) provided ideas, strategies, resources, or tools they will use, (3) was easy to follow, and (4) was highly engaging. To encourage more direct, specific, and actionable feedback, the survey also asked a series of open-ended prompts: (1) What did you like best about this session? (2) What do you think could have been better? (3) What ideas, tools, or strategies do you plan to use in your work? (4) What other resources, issues, or tools would you like help exploring next? Table 1 elaborated on questions and key outcomes.

Table 1. Post-session survey questions

Question	Format	Targeted outcome
Q1. (This session) enhanced my interest in these practices.	Likert scale	This prompt tracked whether participant curiosity for design thinking and specific session topics increased.
Q2. (This session) provided ideas, resources, strategies, or tools I will use.	Likert scale	This prompt tracked learning transfer into the participants' life.
Q3. (This session) was easy to follow.	Likert scale	This prompt tracked whether participants found the learning session to be accessible.
Q4. (This session) was highly engaging.	Likert scale	This prompt tracked whether the learning session captured participants' attention.
Q5. What did you like best about this session?	Open-ended	This prompt tracked design thinking strategies that consistently yield the most value.
Q6. What do you think could've been	Open-ended	This prompt documented opportunities for making

better?		adjustments in educational sessions over time.
Q7. What ideas, tools, or strategies do you plan to use in your work?	Open-ended	This prompt identified strategies participants plan to transfer into their lives.

This post-session survey consistently offered a quick assessment baseline for revision, iteration, and innovation. The extensive data collected also offered valuable learner-centric feedback on the DT process across different educational sessions. For the purposes of this article, we analyzed the data with the following research questions in mind: 1) To what extent does the DT process foster key engaged learning practices and support engaged learning environments? 2) What particular DT practices were noted as being most highly effective for supporting learner-valued goals?

To answer the first research question, we used aggregated averages from the Likert scale results. These results helped us understand how participants rated the sessions' utility and level of engagement. We then segmented by year to estimate descriptive statistics. We used T-tests to assess the homogeneity of outcomes across years, extracting whether there were disparate benefits to the DT pedagogy.

Since survey questions five and seven (Table 1) asked participants to assess the value and engagement of each session, they provided effective data for understanding which DT methods and tools were most valuable. Therefore, we analyzed these questions via discourse analysis. Jaipal-Jamani (2014) and Gee (2011) discuss the inherent value of using learners' own words to assess their lived realities, with convergences in word choice reflecting a shared experience or value for participants across pedagogical interventions. Following their guidance, we developed a shared set of rules through thematic coding to interpret the data using Moore (2023)'s six high-impact practices for engaged learning. Table 2 illustrates the guidance for extracting each of the outcomes of interest.

Table 2. Coding guidance for key engaged learning practices

Outcome	**Explanation for coding**
Building on prior knowledge	The survey response directly commented on an element of the workshop that made the participants consider existing knowledge. If the participant commented on the use, consideration, or application of knowledge derived from past experiences (academic or otherwise), it qualified for this outcome. In some workshops, this outcome was tied to previous academic learning. In others, this outcome was linked to experiential knowledge derived from past experiences.
Facilitating relationships	The survey respondent directly addressed how one or more elements of the workshop encouraged them to engage with each other in a manner that was conducive to building relationships.
Framing connections to broader contexts	The response made clear reference to appreciating opportunities to discuss or consider situations beyond the workshop setting. In practical terms, this meant that the respondent mentioned how a specific activity forced them to think about how the materials related to contexts, situations, or experiences beyond the session.
Offering feedback	The survey respondent noted that they valued how the session encouraged them to give and receive feedback. Mentioning specific activities designed for feedback or how feedback was received and addressed reflected this outcome.

Reflection on learning and oneself	The survey respondent made reference to specific elements of the workshop that prompted introspection. The participant discussed the consideration of different epistemological processes, how they experienced each one, and/or how they affected their experiences with the subject of the workshop.
Integration of knowledge and skills	The respondent discussed how specific activities within the workshop enabled them to apply acquired skills or knowledge.

Three research team members coded responses according to Table 2, categorized by outcome, and counted (to be presented as percentages of total respondents). To assess whether students noted particular methods as especially valuable, we also evaluated all responses for mentions of specific DT strategies. This process helped clarify and elaborate on the findings, increasing their interpretability and validity (Creswell and Plano Clark 2017).

RESULTS

Quantitative findings

Table 2 summarizes the average score and standard deviation for each Likert scale question across all 7,400 responses. With an average value above 6.0 ("Agree") and a low standard deviation for every prompt, it appears that learners felt the sessions were engaging and motivating and that they provided new ideas, resources, and strategies that they considered useful for their lives.

Table 3. Likert 7-point scale question results (1=strongly disagree, 7=strongly agree)

This session…	Average	Standard deviation
Enhanced my interests in these practices	6.08	0.06
Provided ideas, strategies, resources, or tools I will use	6.15	0.06
Easy to follow	6.30	0.01
Highly engaging	6.10	0.08

Given the diverse set of participants, topics, and facilitators represented in the data, we suggest the consistently high ratings indicate the value of both the DT methods implemented and the structure of the educational sessions. For instance, session topics ranged from introductory DT sessions, to strategic planning, to addressing implicit bias, and more. In the 2019–2020 academic year, six pre-set topics for sessions centered around various aspects of DT. During the 2020–2021 academic year, the center added additional workshops that addressed implicit bias and liberatory practices, and participants co-designed 56 customized sessions. During the 2021–2022 academic year, the center introduced two additional session topics, updated a pre-existing workshop on teamwork, and prepared 42 custom sessions. During the 2022–2023 academic year, the center consolidated two of the workshops on prototyping and failure into one, and facilitated 123 custom workshops. Finally, in the 2023–2024 academic year, the center introduced a workshop on designing for wellness and an updated teamwork workshop, with 15 custom sessions.

Over the past five years, there have also been 114 session facilitators, including 32 professional faculty and 82 undergraduate student facilitators. With an average tenure of two years, students are trained in facilitation and DT over the course of their first semester and then assigned to facilitate workshops on their own. Student facilitators represent diverse majors across campus and come from six countries and 12 different U.S. states. With such a diverse set of session topics and facilitators, we found it relevant to consider whether there is any statistically significant variation between-years and session topics. However, a set of t-tests comparing the data by year showed no specific significant differences driving results. That is, the only fixed variable across the data is the overarching DT framework and intentional integration of DT methods.

These findings confirm and extend the wider literature on DT. For instance, Lor's meta-analysis of over 60 empirical studies on DT in education found that these practices fostered creativity, empathy, as well as mindsets valuable for solving complex problems (2017). In contrast, studies focused on longer DT interventions (e.g., semester-long courses, community projects, product/service innovation) have found that participants often experience consistent greater challenges in these programs. Altringer and Habbal (2015), and Liedtka and Bahr (2019), for instance, discussed how participants articulated confusion, anxiety, and stress at different points during the DT process. Differences between the evaluation of individual DT sessions and longer interventions are not surprising, given that the shortened format of workshops limits the capacity to engage with the more complex elements of DT. Furthermore, as an individual session within a wider project or course, instructors typically did not formally grade these sessions. Given the lower stakes and short timeline, participants likely experienced less stress (Altringer et al. 2015; Liedtka et al. 2019).

Engaged learning findings

To explore the connection between the DT sessions and engaged learning (RQ 1), the team next themed responses to the survey question "What did you find most valuable?" according to the six key engaged learning practices. Table 3 summarizes this analysis and notes the percentage of responses to each engaged learning practice alongside a sample excerpt. Analysis of participant responses indicated that they most valued opportunities to offer and receive informal feedback. Many respondents also indicated that they valued getting the chance to frame connections to broader contexts, and opportunities to reflect on their learning and self. In particular, they valued reflecting on their past experiences, positively reframing their failures, and considering their own implicit biases.

Table 4. Most valued design thinking activities and engaged learning practices

Engaged learning	**Approx. %**	**Sample excerpt: I most valued . . .**
Offering feedback	39%	"Giving feedback and coming up with the problem their trying to solve before the issue"
Framing connections to broader context	21%	"The strategy of coming up with ideas to cultivate in our community was very helpful!"
Fostering reflection on learning and self	18%	"The self-reflection of where you are now and where you want to be; it allowed me to really reflect on myself and how I'm going to improve myself."
Promoting integration and transfer of knowledge and skills	11%	"Reflecting on past failures, and making plans to be resilient in the future"
Acknowledging and building on prior knowledge and experiences	7%	"I thought that the personal reflection prior to accessing our social entrepreneurs was very helpful."
Facilitating relationships	4%	". . . using a partner to further my understanding of what it's like to work on a problem that's not mine."

When analyzing what particular DT practices were most noted as being highly effective, we found that experience and mind mapping, sharing stories and strategies from their own lives, and collective tiny task-planning and reporting were most valued. Given their usefulness for fostering engaged learning environments, we detail these strategies in the discussion.

DISCUSSION

Experience and mind mapping are visualization tools that allow participants to organize complex situations into their core components and thus more clearly reflect upon the relationship between ideas and experiences (Davies 2011). While mind maps use word association to prompt reflection, experience maps encourage learners to visualize their past experiences, reflect on who/what the touchpoints are, consider their emotions across experiences, and finally, explore opportunities for growth and improvement (Kalbach 2016; Samson, Granath, and Alger 2017). Participants consistently valued these learning strategies, with many mentioning they were particularly effective for generating actionable insights. One participant noted, "I really liked the mind map because it made me aware of what I had to do to educate myself on these issues and how to overcome uncomfortable conversations . . ." Another participant reflected that mind mapping helped them to "think more outside the box." Throughout the process, these activities required multiple engaged learning practices, including introspection and framing connections to broader contexts; they also prepared learners for the offering and receiving of feedback, ultimately facilitating relationships.

Respondents also consistently valued DT methods that asked them to share their stories and strategies. One participant commented that this particular practice "expanded my network of others trying to reach similar goals." Another noted, "I really like making strategies, and how to visualize them for work, home, and civics." Heavily emphasized within the explore stage, the exchange of

stories and strategies support two main engaged learning practices: relationship-building and framing connections to broader contexts. As structured and interactive spaces for sharing, these activities prompt relational learning, democratizing the learning environment. Within the structure of the DT sessions studied here, sharing stories and strategies occurs after learners have visually explored their ideas. For instance, after exploring their past experiences with mentorship, participants shared stories and subsequent insights with one another. In the exchange of feedback, this learning activity may also be a useful low-stakes prototyping exercise. Popcorn (quick, volunteer idea-sharing) and round-robin (circular, turn-based discussion) engagement strategies may also allow for the cross-pollination of insights. These structured discussions enable session planners to add an additional layer of purpose to one part of the session.

The third practice respondents consistently highlighted was the value of deciding upon and sharing "tiny tasks," a series of manageable next steps. Unlike other elements in the session, which can be shifted and adapted, this activity serves one purpose: to encourage learners to take the session's lessons beyond the classroom. In most cases, this represents the final activity for the session, comprising the Cultivate stage of Elon's process. Once participants have prototyped possible next steps, they will define one or more tiny tasks (many facilitators recommend something that can be done in under 10 minutes). Participants commit to achieving these tasks after they leave the room. Beyond functioning as a call to action, it allows learners to make incremental progress toward larger goals.

Overall, these learning strategies point toward two larger themes in the qualitative data: 1) the value of learning-by-doing in relationship with peers and 2) engaging in semi-structured learning sessions that first prompt and visualize self-reflections, then allow for the sharing of ideas, and, in the end, ensure the actionable transfer of insights into the learner's life outside the session. These findings match Moore's (2023) recommendations, while also reinforcing the value of the DT framework and the learning strategies implemented. For instance, learners were always prompted to consider (and visualize) their background in relation to the topic at hand, build from their prior experiences, and transfer insights into their lives. The process also consistently and iteratively prompted learners to engage with and learn from each other, facilitating relationships.

Recommendations

The consistency between the qualitative and quantitative findings suggests that learners felt that the DT framework and methods were valuable, that they inherently supported the most valuable engaged learning practices recommended by Moore (2023), and that particular strategies were especially effective. As such, educators across disciplines and institutions should more intentionally adapt and incorporate the DT framework and strategies within their learning sessions.

Context matters in the adoption of these strategies. Time, space, and resources should be considered when implementing these strategies. Each of the recommended activities can take anywhere from five to 20 minutes to complete with a class size of 33, and an average group of four learners; however, it may take longer in larger classrooms or groups. When planning for these activities, it can be useful to find a space where tables can be arranged to serve these smaller groups. Furthermore, facilitators' experiences suggest that, after having these opportunities to share within small groups, it may be useful to ask each group to share one insight with the entire room. A large consideration for scalability is that of supplies. While implementing a mind map might be as low-stakes as asking participants to use a sheet of paper and a writing utensil, more structured worksheets may be more useful as learners construct mind maps.

Limitations

In contrast to studies that examine the value of semester-long courses or longer educational programs (Lake, Ricco, and Whipps 2016; Lake et al. 2022; Melles, Howard, and Thompson-Whiteside 2012; Wrigley, Mosely, and Tomitsch 2018), this research examined the value that individual DT educational sessions might yield. In particular, the data reflects self-reported perceptions and intentions immediately following an educational session. While DT can and should move beyond short-term, fast-paced workshops in order to fully understand how it can help transform individuals and social systems, these results reinforce that short-term engagement across topics and disciplines fosters engaged learning. On the other hand, this study examined self-reported participant perceptions and intentions immediately following a learning session. Studies tracking actual outcomes and the perceived longer-term value of DT pedagogical strategies would further validate the effectiveness of DT. Furthermore, this study did not capture data from session facilitators, which may be a valuable avenue for further study.

This study only examined data from Elon University. Students and faculty from this university made up the majority of session participants, though some representation existed from local community members and partnering institutions. This limits the external validity of the results. In addition, to promote learner participation, we did not collect personally identifiable information (including demographic information). Even with these incentives, participants' willingness to respond to the survey was directly tied to their engagement in the session, as well as the approach taken by their facilitator when requesting survey participation. While this may raise concerns about positively biased quantitative outcomes, the homogeneity across years and sessions suggests that this bias is likely marginal.

While we could estimate the percentage of the sample representing undergraduate classes, community, and external partner sessions from the general session information, we cannot determine whether there are heterogeneous benefits based on the population. Thus, participants across diverse demographics may not value the framework and strategies highlighted here. For these reasons, findings should not be generalized to other populations. Future studies that include a diverse participant pool, a variety of institutions of higher education, demographic data, and an examination of the long-term outcomes and value of DT pedagogies are needed.

CONCLUSION

DT pedagogy has developed into a well-studied field, with substantial cross-institutional research and sufficient depth within a wide array of disciplines (McLaughlin et al. 2022; Panke 2019; Taheri, Unterholzer, and Meinel 2016). However, despite widespread implementation across education, the literature is missing studies that examine the impact of individual educational sessions from across diverse contexts and facilitated by a variety of instructors. In response, this paper set out to analyze 1) if (and to what extent) the DT learning framework fosters engaged learning and 2) which DT strategies were most valued by learners. Analysis of quantitative and qualitative data demonstrated that learners consistently viewed the framework as highly engaging and that they found ideas and strategies useful to their lives. In addition, analysis of qualitative data showed that learners most valued DT strategies that help them visualize their thoughts and experiences, the sharing of stories and strategies, and tiny task-planning and reporting. We speculate that participants consistently noted these strategies as most valuable precisely because they prompt engaged learning.

Findings suggest that the DT framework consistently cultivated an engaged learning environment by helping participants experience each of the six key engaged learning practices; that is, this flexible, sequenced, learning framework appears to encourage learners to access prior

knowledge, connect their learning to broader contexts, seek feedback, integrate insights, transfer knowledge, and cultivate relationships. These findings are consistent with and build upon expectations set by previous research into DT pedagogies (Lake et al. 2024; Liedtka et al. 2021; McLaughlin et al. 2023). With these findings in mind, interested instructors from across fields of study and institutions should consider using the strategies outlined and the sequenced learning framework in the design of their educational sessions. Hopefully, this study serves as a starting point for longitudinal studies into the long-term value of DT pedagogies and practices and cross-institutional studies that include a more diverse set of higher education institutions, capture demographic data, and span global geographies.

NOTES

1. Prototyping is often understood as a "making-to-learn" process where ideas are physically manifested through low-stakes, quick processes of making or doing (e.g., roleplay, 3-d mockup, etc.). The testing of prototypes serves to elicit feedback and further develop rough ideas into valuable and viable outcomes.
2. Through systems-thinking, participants explore how components of larger systems interact and evaluate the potential impacts of their solutions.

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ETHICS

The university ethics committee chair of Elon University's Institutional Review Board (21-104) categorized this as educational research via survey and deemed it exempt.

REFERENCES

Akama, Yoko, Ann Light, and Shana Agid. 2023. "Amplifying the Politics in Service Design." *Strategic Design Research Journal* 16 (1): 34–45. https://doi.org/10.4013/sdrj.2023.161.04.

Altringer, Beth, and Fawwaz Habbal. 2015. "Embedding Design Thinking in a Multidisciplinary Engineering Curriculum." In *VentureWell: Proceedings of Open 2015, the Annual Conference of the National Collegiate Inventors & Innovators Alliance (NCIIA)*, Washington, DC, March 19–21. VentureWell.

Ambrose, Susan A., Michael W. Bridges, Michele DiPietro, Marsha C. Lovett, and Marie K. Norman. 2010. *How Learning Works: 7 Research-Based Principles for Smart Teaching*. Jossey-Bass.

Beligatamulla, Gnanaharsha, Janice Rieger, Jill Franz, and Megan Strickfaden. 2019. "Making Pedagogic Sense of Design Thinking in the Higher Education Context." *Open Education Studies* 1 (1): 91–105. https://doi.org/10.1515/edu-2019-0006.

Bransford, John D., Ann L. Brown, and Rodney R. Cocking. 2000. *How People Learn: Brain, Mind, Experience, and Schoo*l. National Academies Press.

Budwig, Nancy, and Amy Jessen-Marshall. 2018. "Making the Case for Capstones and Signature Work." *Peer Review* 20 (2): 4–7.

Costanza-Chock, Sasha. 2020. *Design Justice: Community-Led Practices to Build the Worlds We Need.* The MIT Press.

Crawford, Alan, E. Wendy Saul, Samuel Mathews, and James Makinster. 2005. *Teaching and Learning Strategies for the Thinking Classroom*. The International Debate Education Association.

Creswell, John W., and Vicki L. Plano Clark. 2017. *Designing and Conducting Mixed Methods Research*. 3rd ed. SAGE Publications.

Davies, Martin. 2011. "Concept Mapping, Mind Mapping and Argument Mapping: What Are the Differences and Do They Matter?" *Higher Education* 62: 279–301. https://doi.org/10.1007/s10734-010-9387-6.

Elon Center for Design Thinking. 2018. *Design Thinking Process*.

Felten, Peter, John M. Gardner, Charles C. Schroeder, Leo M. Lambert, and Betsy O. Barefoot. 2016. *The Undergraduate Experience: Focusing Institutions on What Matters Most*. Jossey-Bass.

Felten, Peter, and Leo M. Lambert. 2020. *Relationship-Rich Education: How Human Connections Drive Success in College*. Johns Hopkins University Press.

Gee, James P. 2011. *An Introduction to Discourse Analysis: Theory and Method*. 3rd ed.. Routledge.

IDEO. n.d. *Design Thinking for Educators: Toolkit (Version 2).*

Jaipal-Jamani, Kamini. 2014. "Assessing the Validity of Discourse Analysis: Transdisciplinary Convergence." *Cultural Studies of Science Education* 9 (4): 1–7. httsp://doi.org/10.1007/s11056-014-9301-4.

Jamal, Tazim, Julie Kircher, and Jonan Phillip Donaldson. 2021. "Re-Visiting Design Thinking for Learning and Practice: Critical Pedagogy, Cognitive Empathy." *Sustainability* 13 (2): 964. https://doi.org/10.3390/su13020964.

James, Carrie Lynn, and Saadeddine Shehab. 2024. "Blending HCD with Multicultural Education: Lessons Learned from Co-Designing an Intervention." In *Proceedings of the 18th International Conference of the Learning Sciences (ICLS)*. International Society of the Learning Sciences.

Kalbach, Jim. 2016. *Mapping Experiences*. O'Reilly Media.

Kuh, George D., and Ken O'Donnell. 2013. *Ensuring Quality and Taking High-Impact Practices to Scale*. Association of American Colleges and Universities.

Lake, Danielle, Wen Guo, Elizabeth Chen, and Jacqui McLaughlin. 2024. "Design Thinking in Higher Education: Opportunities and Challenges for Decolonized Learning." *Teaching & Learning Inquiry* 12: 1–22. https://doi.org/10.20343/teachlearninqu.12.4.

Lake, Danielle, Marc Lehman, and Linda Chamberlain. 2019. "Engaging through Design Thinking: Catalyzing Integration, Iteration, Innovation, and Implementation." *eJournal of Public Affairs* 8 (1): 87–113.

Lake, Danielle, David J. Marshall, Rozana Carducci, and Tracey Thurnes. 2022. "The Power and Place Collaborative: Participatory Strategies for Scaling." *Systemic Design Association* 1. https://doi.org/10.58279/v1005.

Lake, Danielle, Phillip Motley, and William Moner. 2023. "Completing the CiCLE: Assessing Longitudinal Ecosystem Change to Improve Community-Based and Design-Centric Immersive Learning." *Social Enterprise Journal* 19 (1): 1–23. https://doi.org/10.1111/sent.12345.

Lake, Danielle, Michael E. Ricco, and Judy Whipps. 2016. "Design Thinking Accelerated Leadership: Transforming Self, Transforming Community." *Journal of General Education: A Curricular Commons of the Humanities and Sciences* 65 (3–4).

Lauff, Carlye. 2022. "Strategies for Assessing and Articulating the Value of Iterative Design." In *Design Forge Presentation*. Elon University.

Liedtka, Jeanne, and Kristina J. Bahr. 2019. *Assessing Design Thinking's Impact: Report on the Development of a New Instrument.* Darden Working Paper Series.

Liedtka, Jeanne, Karen Hold, and Jessica Eldridge. 2021. *Experiencing Design: The Innovator's Journey*. Columbia University Press.

Lor, Rex. 2017. "Design Thinking in Education: A Critical Review of Literature." Paper presented at the Asian Conference on Education and Psychology, May 24–26, Bangkok, Thailand.

Luka, Ineta. 2019. "Design Thinking in Pedagogy: Frameworks and Uses." *European Journal of Education* 54 (4): 499–512. https://doi.org/10.1111/ejed.12367.

McLaughlin, Jacqueline E., Elizabeth Chen, Danielle Lake, Wen Guo, Emily Rose Skywark, Aria Chernik, Tsailu Liu 2022. "Design Thinking Teaching and Learning in Higher Education: Experiences across Four Universities." *Design Thinking in Higher Education* 17 (3). https://doi.org/10.1371/journal.pone.0265902.

McLaughlin, Jacqueline E., Danielle Lake, Elizabeth Chen, Wen Guo, McKenna Knock, and Steve Knotek. 2023. "Faculty Experiences and Motivations in Design Thinking Teaching and Learning." *Frontiers in Education* 8. https://doi.org/10.3389/feduc.2023.1172814.

Melles, Gavin, Zaana Howard, and Scott Thompson-Whiteside. 2012. "Teaching Design Thinking: Expanding Horizons in Design Education." *Procedia—Social and Behavioral Sciences* 31: 162–66. https://doi.org/10.1016/j.sbspro.2011.12.035.

Micheli, Pietro, Sarah J. S. Wilner, Sabeen Hussain Bhatti, Matteo Mura, and Michael B. Beverland. 2019. "Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda." *Journal of Product Innovation Management* 36 (2): 124–48. https://doi.org/10.1111/jpim.12466.

Moore, Jessie L. 2023. *Key Practices for Fostering Engaged Learning: A Guide for Faculty and Staff*. Routledge.

National Academies of Sciences, Engineering, and Medicine. 2019. *A Design Thinking, Systems Approach to Well-Being Within Education and Practice: Proceedings of a Workshop*. The National Academies Press. https://doi.org/10.17226/25151.

Nicol, David J., and Debra Macfarlane-Dick. 2006. "Formative Assessment and Self-Regulated Learning: A Model and Seven Principles of Good Feedback Practice." *Studies in Higher Education* 31 (2): 199–218. https://doi.org/10.1080/03075070600572090.

Noel, Lesley-Ann, Adolfo Ruiz, Frederick M. C. van Amstel, Victor Udoewa, N. Verma, N. K. Botchway, A. Loday, and S. Agrawal. 2023. “Pluriversal Futures for Design Education.” *She Ji: The Journal of Design, Economics, and Innovation* 9 (2): 179–96. https://doi.org/10.1016/j.sheji.2023.04.002.

Panke, Stefanie. 2019. “Design Thinking in Education: Perspectives, Opportunities and Challenges.” *Open Education Studies* 1: 281–306. https://doi.org/10.1515/edu-2019-0022.

Rauth, Ingo, Eva Köppen, Birgit Jobst, and Christoph Meinel. May 2010. “Design Thinking: An Educational Model towards Creative Confidence.” Paper presented at First International Conference on Design Creativity, Kobe, Japan.

Royalty, Adam, and Bernard Roth. 2016. “Developing Design Thinking Metrics as a Driver of Creative Innovation.” In *Design Thinking Research*, edited by Hasso Plattner, Christoph Meinel, and Larry Leifer. Springer.

Samson, Sue, Kim Granath, and Adrienne Alger. 2017. “Journey Mapping the User Experience.” *College & Research Libraries* 78 (4).

Shehab, Saadeddine. 2019. *“Collaborative Problem Solving in Higher Education Classrooms: Exploring Student Interactions, Group Progress, and the Role of the Teacher.”* PhD diss., University of Illinois at Urbana-Champaign. https://hdl.handle.net/2142/105908.

Taheri, Mana, Thomas Unterholzer, and Christoph Meinel. 2016. “Design Thinking at Scale: A Report on Best Practices of Online Courses.” In *Design Thinking Research*, edited by Hasso Plattner, Christoph Meinel, and Larry Leifer. Springer.

Udoewa, Victor. 2022. “Radical Participatory Design: Awareness of Participation.” *Journal of Awareness-Based Systems Change* 2 (2): 59–84. https://doi.org/10.47061/jasc.v2i2.3816.

Udoewa, Victor, and Savannah Keith Gress. 2023. “Relational Design.” *Journal of Awareness-Based Systems Change* 3 (1): 101–28. https://doi.org/10.47061/jasc.v3i1.5193.

Vink, Josina. 2022. “Designing for Plurality in Democracy by Building Reflexivity.” *The Pluralist* 17 (1): 52–76. https://doi.org/10.5406/19446489.17.1.06.

Vink, Josina, Bo Edvardsson, Katarina Wetter-Edman, and Bård Tronvoll. 2019. “Reshaping Mental Models—Enabling Innovation through Service Design.” *Journal of Service Management* 30 (1): 75–104. https://doi.org/10.1108/JOSM-08-2017-0186.

Waity, Jill, Alicia Sellon, and Bailey Williams. 2023. “Using Design Thinking to Solve Real-World Problems: A Pedagogical Approach to Encourage Student Growth.” *Journal of Effective Teaching in Higher Education* 6 (2): 17–34. https://doi.org/10.36021/jethe.v6i2.350.

Wrigley, Cara, Genevieve Mosely, and Martin Tomitsch. 2018. “Design Thinking Education: A Comparison of Massive Open Online Courses.” *She Ji: The Journal of Design, Economics, and Innovation* 4 (3): 229–49. https://doi.org/10.1016/j.sheji.2018.06.002.

Wurdinger, Scott, and Mariam Qureshi. 2014. “Enhancing College Students’ Life Skills through Project-Based Learning.” *Innovative Higher Education* 40: 279–86. https://doi.org/10.1007/s10755-014-9314-3.

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