Applying Design Thinking Principles to Curricular Development in Medical Education

Michael Gottlieb, MD, RDMS, Emilie Wagner, MBA, Alexei Wagner, MD, MBA, and Teresa Chan, MD, MHPE, FRCPC

ABSTRACT

Medical education is an ever-evolving field, resulting in numerous changes and modifications to curricular structure, learner assessment, feedback, and remediation. To best meet the needs of the individual learners, it is important to design curricula that meet their *real* needs. Design thinking (DT) first gained popularity in the 1960s and, since then, has been applied to problem solving within business, primary education, and medicine. The process involves five stages: discovery, interpretation, ideation, experimentation, and evolution, which are targeted toward empathizing with end-users to uncover and design for unmet needs. In this paper, we describe the five-stage DT approach with specific application to medical education and discuss future directions within the medical education field.

When designing or modifying a curriculum, it is important to design components targeted for the end-user. While medical educators have always emphasized the importance of needs assessment when designing curriculum, most needs assessment techniques mentioned in the literature hinge on surveys or other quantitative methods for gathering information about the needs of learners.[1–4] Design thinking (DT)[5–7] is a technique that builds on existing approaches to curricular design by emphasizing the importance of the end-user and multiple sources of data. DT has traditionally aligned more with the arts and social science disciplines[5–7] by utilizing techniques that are more aligned with constructivist epistemologies and investigatory techniques (e.g., ethnography, qualitative interviews). Qualitative traditions are grounded in the constructivist paradigm, which yield different types of inquiry that incorporate different assumptions. Essentially, those fields emerging from constructivist epistemologies differ in their approach to how "truth" is generated.[8] The constructivist paradigm is often contrasted with positivist thinking, which underpins the more traditional "scientific" (i.e., hypothetical-deductive) approaches to truth. Positivist traditions assume that there is a central, underlying truth that may be approximated, approached, or deduced via scientific methods.[8] Constructivist paradigms work under the assumption that aspects of reality are constructed by those who view it and, as such, reality is subjectively interpreted by investigators as they examine a phenomenon.[8]

The DT approach expands significantly upon the traditional approach to curricular design, by emphasizing qualitative methods to data gathering and the incorporation of extreme users (i.e., similar to the way a qualitative researcher might use intentional sampling to ensure that one might saturate their data sampling). Additionally, DT extends the developmental stage by

From the Department of Emergency Medicine, Rush University Medical Center (MG), Chicago, IL; Stanford, CA (EW); the Department of Emergency Medicine, Stanford University Medical Center (AW), Stanford, CA; and the Department of Medicine, Division of Emergency Medicine, McMaster University (TC), Hamilton, Ontario, Canada.
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Supervising Editor: Jonathan Ilgen, MD.
Address for correspondence and reprints: Michael Gottlieb, MD; e-mail: michaelgottliebmd@gmail.com.
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involving users throughout the different stages of development, as the designers works toward a tangible curricular intervention.

Despite new popularity in mainstream media, DT has been present for over 40 years.[5–7] Initially, DT was discussed as a theoretical approach to problem solving, particularly with regard to ill-defined, difficult-to-solve problems.[9] Subsequently, multiple design programs were developed worldwide. DT has been utilized in a variety of different fields, including business,[10–16] law,[17] primary school education,[18] sciences,[19–22] and medicine.[23–34] The use of DT within medical education has been limited, but is emerging. With the shift in medical education to become more inclusive of qualitative research and discovery work, it is fitting for us to highlight these need finding and assessment techniques, as they naturally integrate into the diversifying movement within the field.

DESIGN THINKING

Design thinking is a set of tools and mindsets used to tackle problems of any scale. It is an iterative and dynamic approach that grounds itself firmly in the needs of the end-user. DT relies heavily on "abductive logic," meaning the logic of what *might* be, rather than "deductive logic," which is the logic of what should be or is.[16,35,36] In part, this underscores the importance of generating an expansive list of potential solutions derived from sources both within and outside the field of focus leading to a well-tested, user-focused solution.[21,36]

Depending on the resource, the titles for the various steps comprising the DT process vary slightly. However, the concepts underlying these steps remain similar. Here we have chosen to use these titles to describe the five stages: discovery, interpretation, ideation, experimentation, and evolution,[38] which will be outlined further in the following sections. Medical educators will note that these five stages are more explicitly tailored toward change and rapid innovation, rather than the traditional curricular design frameworks (e.g., Kern et al.[1]), which have evaluation as a last step, but less explicitly encourage designers to actively experiment and modify their curriculum. It is important to note that these steps are not always linear and it is common to cycle back through the earlier stages multiple times prior to completing a project.[39] Throughout this process, cooperation and collaboration are critical (see Table 1). It is also important to assemble a diverse team with people from a range of different fields and viewpoints.

Table 1
Important Mindsets for Successful Design Thinking

Empathize with your user	Approach your user as a naïve and curious outsider (you are not designing for yourself, you are designing for your user).
Bias toward action	Take risks so that you can fail and learn quickly. Create a "culture of prototyping" that focuses on being highly experimental and trialing solutions in tangible ways that go beyond theoretical discussions.
Be open and suspend judgment	Learn from others and be careful not to shut others down or insert your own biases.

DESIGN THINKING PROCESS

Discovery

Discovery builds the foundation for the subsequent steps. In this stage, practitioners use design research methods to gather information that enables problem identification and hypothesis generation. It is important to avoid interpreting or judging throughout this stage. Observation and interviewing are two valuable design research methods within the discovery phase. Henry Ford once said: "If I'd asked my customers what they wanted, they'd have a faster horse."[39] Often, people cannot directly describe what their needs are, but observing their actual behaviors or seeking specific stories provides invaluable clues around a range of unmet needs.[39] During this stage, one should seek out extreme users, end-users who are at opposite extremes, and learn from the different issues, needs, and workarounds they have developed.[39] Gaining empathy with extreme users leads to identification of rich insights that can later be validated with users in between the two extremes. For the purpose of this phase, it is important to consider all of the stakeholders involved and understand how they are interconnected. For instance, when designing a new resident data management system, it would be important to consider both the needs of residents and the program administrators who will use the data for programming or counseling (for further examples of techniques, please see Table 2).

Interpretation

Interpretations transform the observations from the prior step into meaningful insights. First, work in a

Table 2
Techniques for the Different Steps in Design Thinking

1. Discovery	
Interview people	Speak with people at various stages from expert creator to end-user. Prepare a question guide in advance, but be flexible to follow the conversation in an unexpected direction.
Observe	Immerse yourself in an experience relevant to your design thinking challenge. Look for inspiration in analogous scenarios as well. Remember to take extensive notes for analysis later.
User diaries	Ask users to record their activities for several days to weeks. Ask them to document why they chose to record certain details and how they felt about them.
Group discussions	Bring together a panel of participants and observe the conversations, as well as shared impressions and concerns.
2. Interpretation	
Tell a story	Share your thoughts and insights from the discovery stage with the group. Actively listen to others' stories and assess for commonalities and differences.
Search for meaning	Begin by clustering the different components of the stories into central themes. Create titles or general categories for each theme. Use the themes to identify insights.
Frame opportunities	Make the insights actionable by creating "How might we …" questions.
3. Ideation	
Brainstorm	Set aside dedicated time and encourage active participation and lots of ideas. Keep the energy high by switching to another brainstorming topic when the energy begins to fade.
Select promising ideas	Combine similar ideas into categories. As a group, select the top ideas.
Refine ideas	Determine what is at the core of the idea. Determine any potential constraints and solutions to those constraints.
4. Experimentation	
Create a prototype	Create a prototype to share the idea with others. Examples include storyboards, diagrams, fake advertisements, electronic mock-ups, models, and real-life simulation.
Solicit feedback	Select multiple people from various backgrounds and perspectives to provide feedback. Identify trends and refine or change the prototype based upon the responses.
5. Evolution	
Measure impact	Determine the impact of the proposed solution, as well as potential pearls and pitfalls for future endeavors.
Build partnerships	Identify partners who can help facilitate the continued success of your current idea, as well as work on future ideas.
Reassess	Reassess your progress and consider future directions and projects.

Adapted from the IDEO Design Thinking for Educators Toolkit (available at: https://www.ideo.com/work/toolkit-for-educators).

group to organize the information gathered in the discovery phase into themes, then examine and discuss the information within each theme to develop insights about the user and their needs. The overall goal of this stage is to create an actionable problem statement that is more nuanced and specific than the original challenge because it now originates from newly uncovered needs. For example, if the original question focused on how to increase emergency medicine residents' academic session attendance it may evolve to focus on how to make academic sessions accessible to the residents while cycling on an off-service rotation.

Ideation

Now that a problem area has been identified, one should focus on idea generation. Brainstorming as a group is a crucial component of this step. Every member of the group should defer judgment and be actively encouraged to contribute ideas ranging from obvious to absurd. Sometimes, the most extreme ideas will be the most valuable, as they can lead to the generation of novel, great ideas. Brainstorming prompts are used to provide inspiration and focus for idea generation. One example of a prompt is a "How Might We …" (HMW) statement. The "how" assumes that there is a solution. "Might" assures it is acceptable whether an idea works or not. "We" emphasizes collaboration. The prompt works as a source of inspiration for idea generation that broadens perspectives, discovers connections, and generates unexpected ideas. For example, "How might we offer academic sessions during all hours of the day?" Or "How might we make attending an academic session the favorite part of a resident's training?" Or "How might we have emergency medicine residents on off-service rotations lead the academic sessions?" Each idea in response to the HMW statement can be written on a sticky note and collected on a poster board or wall. Difficult concepts may be clarified by including a drawing. The sticky notes can then be rearranged into clusters that demonstrate trends in ideas. Next, the team evaluates and selects an idea or set of ideas to move forward

with based on agreed upon constraints (e.g., most feasible to implement, falls within the budget).

Experimentation

During the experimentation stage, prototyping is used to understand how end-users respond to the idea and how it can be refined to optimally align with their needs. Prototypes range from low fidelity (e.g., drawings on paper) to high fidelity (e.g., real-life simulations). In this stage, participants should adopt a bias toward action by running several prototypes with each designed to test a specific assumption within the idea or new iteration of the idea. To do this, participants should create the minimum prototype needed to understand the key assumption they are testing. The more "finished" a prototype is, the less likely users are to provide candid and honest feedback.[23] The goal of prototyping is not to make a perfect representation, but rather to make it tangible, actionable, and testable. This enables early identification of an idea's strengths and weaknesses, so that one may further improve and refine the idea. An example of a very-low-fidelity prototype is to make a list of virtual academic sessions and gather residents' reactions to each topic to gauge their interest and likelihood to attend remotely. A higher-fidelity prototype would be to host a virtual academic session through Skype with a small set of off-cycle rotation residents and gather their feedback at the end.

Evolution

Evolution is the development and changes that happen to the proposed solution after implementation. DT is a cyclical and iterative process. Once a solution is discovered, the group can cycle back to further problems within this project or move on to the next project.

APPLICATION TO MEDICAL EDUCATION

Design thinking could be readily applied to medical education given its human-centered nature with a focus on the end-user. DT complements traditional curriculum planning approaches described for medical education[1,40] by emphasizing techniques for data collection that help the educational designers to construct a meaningful representation of the stakeholders' problems. To do so, DT emphasizes a human-centered approach to problem identification, urging the educational designer to clearly and empathetically understand the needs and problems faced by their students or trainees. Traditionally, needs assessments in medical education have adopted approaches such as quantitative surveys of learner perceptions regarding an educational experience. However, this does not acknowledge the importance of the educator's interpretation on the learners' needs, nor does it take advantage of the insights that might be gained if the educational designer were to apply a constructivist approach to the problem identification process, thereby co-constructing with the learners to identify the underlying problems that drive the stakeholder's perspectives.

One example where DT may be valuable is in redesigning of a residency program's academic schedule. Traditional techniques for surveying the needs of stakeholders would typically utilize surveys, which quantify the preferences and desires of end-users based on the designer's best guesses. A DT approach would incorporate a deeper understanding of the end-users, utilizing more qualitatively grounded techniques to explore their perspectives.

The DT team tackling this challenge would begin with the discovery stage by observing several resident conferences and taking notes in a highly structured framework; conducting 1:1 interviews with both residents (users) and faculty (creators); and then meeting with medical students, emergency medicine residents, non–emergency medicine rotating residents, and faculty to discuss the topic together. Each DT team member would then share the stories, anecdotes, and direct quotes they gathered with each other and together identify patterns and themes around newly uncovered user needs. Next, the DT team would write a refined challenge based on the needs and insights gleaned, followed by an idea generation session with a diverse group of people. In our experience, it is best to have no more than six people in a brainstorm to balance a breadth of input with encouraging all members to be actively involved. However, when there are larger numbers of total participants, you can address this by having several groups tackle the same problem at the same time. Each group would leverage prompts such as HMW statements to focus their idea generation and encourage participants to build on each other's ideas. For example, "How might we make attending an academic session the favorite part of a resident's training?" may lead to "let's move the lectures outside when there is nice weather," which then leads to "let's change the venue and interleave small and large group sessions." After brainstorming, ideas are narrowed to those best aligned with the team's goals. Finally, the DT team would move into prototyping

selected ideas with the users (residents). For example, during the next lecture day the DT team could lead the session following a new agenda and format, gather feedback, and develop a refined lecture day format for further testing until a highly improved design is achieved.

POTENTIAL LIMITATIONS

While embarking on the end-to-end design process can provide significant value, it is time-consuming and requires the involvement of a significant number of people. One must be cognizant of project deadlines and available resources when considering this technique. Of note, success can often be achieved by leveraging only a few of the tools or components of the process, depending on the project's timing and needs. Additionally, given the highly interactive nature of this approach, it is essential that team members are open, active, and engaged. Inclusion of team members who are dismissive or uninterested may decrease the success of this approach.

CONCLUSIONS

Design thinking is a series of techniques and mindsets that encourages empathy, collaboration, and biasing toward action to spark innovation. Given the importance of the above traits in medical education, this appears to be a valuable addition to those looking to improve challenging problems in medical education. It aligns well with other movements within our field, both incorporating a human-centered approach to education and incorporating more qualitative or divergent thinking. There are multiple resources available that can provide further information on this topic.[41,42] Future research will assess the application of DT within the field of medical education, as well as best practices in medical education.

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