Teaming up to Improve Medical/Healthcare Education: Instructional Design & Learning Engineering

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Abstract: As medical and healthcare education becomes more complex, especially with respect to data availability and the use of technology, those who teach in the field may find it difficult to keep up with the changes. Instructional Design teams in which Learning Engineering plays a central role can enable medical and healthcare educators to expand their knowledge and skills in education, technology, and data use. This paper describes the composition and expertise of such teams and explores how they can enhance medical and healthcare education.

Keywords: instructional design, learning engineering, collaboration, team, data, instructional technology

Instructional Designers (IDs) share a common grounding in educational sciences, research, and theory. Over time, IDs also develop and refine their skills and knowledge in different areas (e.g., assessment, curriculum development, instructional technology, analytics). An ID's expertise in one area, however, does not necessarily translate directly to expertise in another area, and even within one area, different IDs can have different capabilities. To be successful working in medical and healthcare education (M/HE), IDs can also develop additional skill sets in such areas as simulation, interprofessional education, and communication in healthcare settings, that are not covered in most traditional instructional design programs. Attaining and maintaining these skills adds complexity to the job of the ID and their growth and development.

Many different terms and titles have been used, sometimes interchangeably, to describe what IDs do in the field (e.g., instructional systems designer, curriculum builder, educational technologist). Now, however, a new term is entering into this complex field: Learning Engineering. Though the concept of the learning engineer was first mentioned in the 1960s by Herbert Simon, it has seen a renewed surge in interest over the last 10 years. Education professionals are asking questions such as: What makes up expertise in Learning Engineering? How do Learning Engineering skills relate to, expand upon or differ from the skills of IDs in a variety of fields, including M/HE? "Instructional Designer" is a role that many outside of the field have a hard time comprehending, and the emergence of the concept of Learning Engineering can generate additional confusion. This paper will briefly describe the current professional identity of the ID and explore the composition of Instructional Design teams, and examine how Learning Engineering can be incorporated into those teams in ways that enhance the ability to sup-

port teaching and learning effectively. The paper will delineate the need for seeing the teams as integral parts of the educational process for them to provide the most effective support for M/HE, and provides examples of what such support could look like.

Instructional Design Activities in Higher Education

One key element of the ID role throughout its history has been to help connect faculty and other educators to best practices in instruction, teaching and learning, and, later, instructional technology. IDs working in a variety of arenas tend to have common foundations on which they can build, and many develop specialized knowledge when working in a specific field such as M/HE. Campbell, Schwier, and Kenny (2009) state that IDs work directly with faculty to help them think more critically about a range of issues related to instruction, including the needs of learners, curriculum, learning environments, policy development, etc. Another field that is highly relevant to IDs is "learning sciences," which is an interdisciplinary field that works to further scientific understanding of learning in all environments which learning occurs (Merrill, Drake, Lacy & Pratt, 1996). The empirical and theoretical underpinnings of neuroscience, cognitive science, instructional design, data analytics, computer science, psychology, user interface design, education/training, and many others have formed the foundation of the discipline.

Even as Instructional Design teams incorporate skills and research from a wide variety of fields into their work, they must also be able to explain those decisions in ways that make sense to the faculty members with whom they are working. Campbell et al. (2009) suggest that "Clients working with instructional designers in educational projects are actually engaging, as learners, in a process of professional and personal transformation that has the potential to transform the participants and the institution" (p. 646). Thus, IDs are most effective when they serve as instructors in interactions with a client and can adapt their approach to the needs of the client.

The relationship of IDs to their primary role of supporting instruction and learning is premised on the fact that many IDs are also educators, and that good teaching and learning practices are the primary focus of their work. Many researchers on effective teaching and learning (Anderson & Carta-Falsa, 2002; Darling-Hammond, 2005; Gage, 1989; Seidel & Shavelson, 2007) express what those in the education field have known for decades: Teaching is a complex activity, and effective teaching is closely tied to the success of learners (Angelo & Cross, 1993; Dick & Carey, 1990; Kern, Thomas, & Hughes, 2009, Shulman, 1999; Sorcinelli, Austin, Eddy & Beach, 2006).

Given the complexity of teaching and learning, instructional designers can amplify the effects of their interventions by working as part of a multifaceted team (Crowley, Chen and Cerver, 2018; Hixon, 2008; Rowley, Bunker and Cole (2002), as cited in Kenny, Zhang, Schwier and Campbell, 2005). The benefits of working in teams is especially pronounced in a specialized field like M/HE. In many environments, the ID collaborates with other learning professionals (e.g., graphic designers, software or application developers, subject matter experts, faculty, medical illustrators, etc.) to create a strong educational product. In such cases the ID frequently serves as a project manager, and the team can be considered an Instructional Design team. Like the director of a movie, an experienced ID guides the theoretical, artistic and technical aspects of a project, visualizing the end state while guiding the entire team in the fulfillment of that vision.

The specific role Instructional Design team members will play on any project depends on the objectives of the project but also on their experience and expertise. The foundation for members of the team lies in their academic preparation, which introduces them to theories, models, and the systematic approaches unique to their specialty. Instructional Design teams must work together to conceptualize and plan products. In a team environment, each of the members of the team take on different roles or tasks. For example, IDs might research new innovations in both learning design and education and apply theoretical models of learning into the design of educational/training products; instructional technologists, graphic artists and medical illustrators might develop educational materials (using both high technology and low/no technology approaches); curriculum specialists might evaluate products; and training specialists might provide professional development sessions on how to use the products effectively. In Instructional Design team work, there are

few situations with only a single right answer, and a learning/instructional problem can be solved in many ways. The background and training of Instructional Design teams helps them identify the range of possible solutions and also select one that will be effective. McDonald (2011) quotes Nigel Cross as stating that, for the ID: "Designing is a process of pattern synthesis, rather than pattern recognition. The solution is not simply lying there among the data... it has to be actively constructed by the designer's own efforts" (p. 24).

Instructional Design team members need to have a familiarity with current theory, data, and research in each of their fields to provide effective services as described above, and they also need to be well-versed in the growing world of technology as an implementation tool. It is also helpful if the Instructional Design team members have an institutional understanding of the environment in which the educational product will be placed.

Enter Learning Engineering

In the complex, dynamic environment described above, a new term has come into play: Learning Engineering. In December of 2017, the Institute of Electrical and Electronics Engineers (IEEE) Standards Board recommended the creation of a new 24 month activity to provide definition to and support for the burgeoning field of Learning Engineering. In 2019, this activity was renewed for another 24 months until 2021.

Learning Engineering is an interdisciplinary approach based on an in-depth foundation and education in proven theoretical models and methods, educational paradigms and approaches, and methods of science and data (Lieberman, 2018; Educause Learning Initiative, 2018). The IEEE Industry Connections Industry Consortium on Learning Engineering (ICICLE) Competencies, Curriculum, and Credentials (CCC) Special Interest Group (SIG) states that:

> Learning Engineering is a *process* and *practice* that
> 1. applies the learning sciences,
> 2. using human-centered engineering design methodologies, and
> 3. data-informed decision making to support learners and their development. (IEEE CCC SIG, 2019)

Learning Engineering, like Instructional Design, needs to be grounded in learning science, applying existing science and generating data to improve, achieve, and even transform learning outcomes. However, the emerging field of Learning Engineering provides a more focused emphasis on big data, using validated methods that put large amounts of educational data to work in the service of improved student success and institutional effectiveness (Lieberman, 2018). Learning Engineering incorporates knowledge of what makes good learning design but also may encompass innovation, learning science, learning analytics, data visualization, data modeling, and **enterprise** learning technologies (how to scale innovations across the learning ecosystem).

There is some debate about the extent to which Learning Engineering overlaps with Instructional Design, since it is possible for an ID with research and experience to gain expertise in the areas sometimes seen as unique to Learning Engineering. One distinguishing element of Learning Engineering is the academic preparation and the grounding of its practice, with an approach that focused more on big data, using statistical modeling approaches for analyzing and visualizing large datasets, or detailed analysis of educational standards, to improve learning. Befitting the word "engineer," they tend to use computer science as well as engineering processes in identifying and/or solving problems. Learning Engineering can thus be placed amongst the professions, where people can have a background in a professional field, such as analytics, but also can be a learning engineer within that field because they fill that role on a learning support team.

The Evolution of Instructional Design Teams

As the amount and type of data available grow, the potential benefits of using that data in instructional planning increase, and the possible applications of enterprise technology in teaching and learning expand. In this environment, incorporating a Learning Engineering approach into the Instructional Design team shows substantial promise, especially in a technical field like M/HE where evidence and data-based decision making are crucial. Bringing together the ID, graphic designer, videographer, technology specialists, simulation expert, medical illustrator, etc. along with,

say, an expert in data analytics, to solve educational challenges starts our journey of reimagining the future and roles of faculty support teams.

Learning Engineering teams would focus on the use of big data and data analytics, visualization and modeling, and enterprise technologies. Implementing technology is not the goal of Learning Engineering teams—good instruction and learning are the focus. One important factor to recognize is that in a team environment members of one team may work with or be a subset of another. A typical alignment for a Learning Engineering team may be a subset of the Instructional Design team, given the distinguishing elements of the roles and the overarching team's attention to teaching and learning. The focus here is less on what individual people do when they carry out a project, and more on what it *means* to be part of a team and participate in the culture of support for education, technology, curriculum, teaching, data, learning, etc.

An exploration of the appropriate use of teams can provide insight into ways that they can be successful in M/HE settings. First, let's examine the role of teams in the curriculum or course design and development process. Teams are likely to work on a variety of projects; they can focus on supporting one faculty member, an entire department, a school, or the leadership at the department, school or university level. Yet the way that these teams are viewed within the university system can have a substantial impact on the work they can do. While these teams serve many roles in the educational landscape, many people in the educational environment still see them as an extension of technology support and the help desk, rather than as credentialed teaching and learning professionals. This misapprehension can lead to situations in which people come to the learning support teams for "just-in-time" support rather than on a timeline that allows analysis and planning. As an example, instructional designers surveyed by Intentional Futures identified "struggling to collaborate with faculty" as their top challenge, followed by lack of time and resources (Intentional Futures, 2016). Collaboration and partnership between educators and IDs have not yet become commonplace, and there remains much uncharted territory. In part, IDs point to a misconception held by many faculty members that online learning works using a "set it and forget it" approach (Intentional Futures, 2016, p. 3), suggesting that instructional design work can be done once and does not require ongoing evaluation and modification.

Setting up Instructional Design and Learning Engineering Teams for Success in M/HE

So, how can these Instructional Design and Learning Engineering teams contribute to M/HE? The importance of specialized teaching and learning support in M/HE can be seen through a review of the Liaison Committee on Medical Education (LCME) documentation on accreditation, which lays out the "Function and Structure" required in an accredited medical school. There are 12 comprehensive standards covering many aspects of roles IDs provide, such as providing appropriate, information technology resources /staff, resources, including opportunities for self-directed learning; preparing students for lifelong learning; allowing for ongoing monitoring, review and revision of instructional objectives; and giving students "opportunities to learn in academic environments that permit interaction with students enrolled in other health professions, graduate and professional degree programs, and in clinical environments that provide opportunities for interaction with physicians in graduate medical education programs and in continuing medical education programs" (AAMC & AMA, 2019, p. 9).

The grounding elements of curricular design and management, the systematic review and critical appraisal of the quality of existing materials, and a theoretical and practical understanding of innovation related to the use of data, which AAMC and AMA articulated as key functions of a medical school, are central to the work of both teams. These teams can be involved with the entire instructional process or with portions of it in their interactions with clients. Using research and theory to inform decision-making that supports learning, Learning Engineering and Instructional Design teams will work to ensure solid analysis takes place before design and development occur. Knowing the significance of goals and objectives in the medical school accreditation process, specialized teams will also emphasize the importance of evaluation to ensure goals are met.

Faculty members in the M/HE realm already seek specialized teaching and learning

services. Anderson, Love and Haggar (2019) conducted a survey of self-identified instructional designers working in medical education, receiving 72 responses. The responses to the survey give a good sense of the variety of roles instructional designers play in M/HE.

> They spend the majority of their time advising faculty on pedagogy and teaching best practices (n = 59, 82%), followed by developing professional development training (n = 55, 76%), advising faculty or staff on how to use educational technology (n = 54, 75%), and designing/building e-learning modules for subject matter experts (n = 52, 72%)" (p. 509). While IDs work closely with faculty, they also work with non-academic staff and other IDs multiple times a week and work with both information technology specialists and senior leaders/administrators once a week on average. IDs also occasionally work with external educational technology providers, students, and librarians. (p. 509)

As discussed previously, Learning Engineering team members can bring additional skillsets that would be of use to medical educators, such as data analysis and visualization.

For Instructional Design and Learning Engineering teams to help generate the desired instructional outcomes, they must be seen as integral parts of the educational process rather than troubleshooters, which changes the entire learning community of an organization. Such an organization emphasizes partnership as the foundation of the working relationship between learning support teams and faculty members, and value educational expertise as much as subject matter expertise. The best support comes from the collaborative nature of the exchanges between and amongst the educators. Wenger (2000) helps us understand the importance of setting up relationships of collaboration and partnership within the learning community. He explains that members of a community come together when they pursue shared interests and engage in activities and discussions together, helping each other and sharing information that enables them to learn from one another. Several studies offer examples of partnerships between IDs and educators (e.g., Byun, Hallett, & Essex, 2000; Meyen, Tangen, & Lian, 1999; Wright & Miller, 2000). Qualities for IDs such as mentoring, sensitivity, the ability to suspend judgment, rapport building, goal setting, providing feedback, and monitoring can help them foster and thrive in a collaborative environment. The findings of Anderson, et al., (2019), as described above, make clear that the need for collaboration between faculty/staff and learning specialists has broadened substantially in the area of technology, and it now encompasses many more aspects than its creators could have foreseen.

As a hypothetical example, consider a new assistant professor in a Radiology department who is asked to teach an existing classroom-based course on Nuclear Medicine, and also to enhance an online version of that course. This professor might initially seek out information from the Instructional Design team about how to modify the syllabus in the learning management system (LMS) or how to upload recorded lectures into the LMS, but also be put in touch with members from the Learning Engineering team to take a deep look at the data on student learning within the various course offerings, which might lead the professor to want to make additional enhancements. For example, the Learning Engineering team could work with the professor to gather information about what course resources are used when and by whom from the university's LMS and video streaming server, and could analyze it and map it to data provided by students in responses to a survey, or to test results. The professor might then choose to work with members of the Video Production or Development team to develop different types of interventions (shorter topic-based videos, or text pieces instead of long full lecture videos) and deploy those new versions at different times throughout the semester, or to different groups of students, in order to support all students in meeting both the course objectives and their individual learning goals. The larger Instructional Design team might also work collaboratively to develop a dashboard (using data analytics experts, developers, graphic artists, instructional designers, and user interface specialists) to develop a product that would allow the instructor to monitor relevant information during the semester and add resources when they are needed.

Learning Engineering teams could also support M/HE faculty who want to take advantage of the growing amount of data available to them. In 2012, Beath, Becerra-

Fernandez, Ross, and Short (2012) stated that "in most organizations the volume of data is expanding by 35%-50% every year - and this number could be even greater now". This growth of data highlights the benefits a Learning Engineering approach to help learning teams determine how to use that data, along with insights from learning science, to improve and enhance learning in M/HE programs. For example, a Learning Engineering team could help a department identify which students are struggling in which portions of the curriculum, and then work with other members of the Instructional Design team to design and develop appropriate interventions to support those students (at the individual or group level), and examine which of those interventions were the most successful.

Finally, Learning Engineering teams could help M/HE faculty and staff keep up with trends in data and emerging technology. Robin, McNeil, Cook, Agarwal, and Singhal (2011) discuss how technology and education have evolved and changed our thinking and practice in M/HE in numerous ways, while also highlighting the trends that suggest that we must adapt our instructional strategies to adequately educate the next generation of health care professionals. One example is the growing use of simulation and virtual reality/ augmented reality (VR/AR) in M/HE. Students are using human cadavers less and increasing use of VR/AR and simulation. The information provided by these environments requires entirely new ways of thinking about instructional strategies, exercise development, assessment and evaluation. Learning Engineering and Instructional Design team members can collaborate with faculty to envision them in new and different ways.

Conclusion & Recommendations

As M/HE grows and becomes more complex, those who teach in the field may well find it difficult to keep up with the changes. Instructional Design and Learning Engineering teams will bring together specialists in the realm of education who can help those who are teaching to transform learning environments for their students and to expand their own knowledge and skills in the use of best practices and education. Instructional Design and Learning Engineering teams supporting M/HE should be made up of many professionals, who have differing expertise (though there may be some overlap among team members) and a strong grounding in teamwork, problem solving, and collaboration. As the positions and teams evolve going forward, we need to be sure that support teams working at the same institution have clearly defined roles, responsibilities, and understandings of collaboration so that both they and the University personnel with whom they work know whom to approach for different needs.

The combination of knowledge and experience, with the ability to filter knowledge through the lens of experience, characterizes the Instructional Design and Learning Engineering teams' approaches to instructional solutions in M/HE. The value of these teams in M/HE environments does not lie entirely in their current individual abilities, but also in their ability to grow and develop their individual expertise areas and address the volume of data, research, and competencies that are growing in M/HE. They bring the greatest strength when they are working in team environments, bringing the highest levels of knowledge and experience in a particular area to solve a particular challenge for the team.

Teams supporting education and technology use in M/HE are likely to continue to develop and build as academic disciplines, certificates, competency boards and programs get engaged in the conversation, but we must ensure that the knowledge and ability to work in teams, collaborate with others, support innovation, and implement change is at the heart of any efforts. We must also ensure that those in charge of instruction and leadership in those organizations recognize the benefits of the teams that bring together various expertise, and thus ensure that they play an active and valued role in the community/team and in the educational process.

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