Operationalizing the Learning Engineering Process to Create an Online Training: An Example from MIT Open Learning

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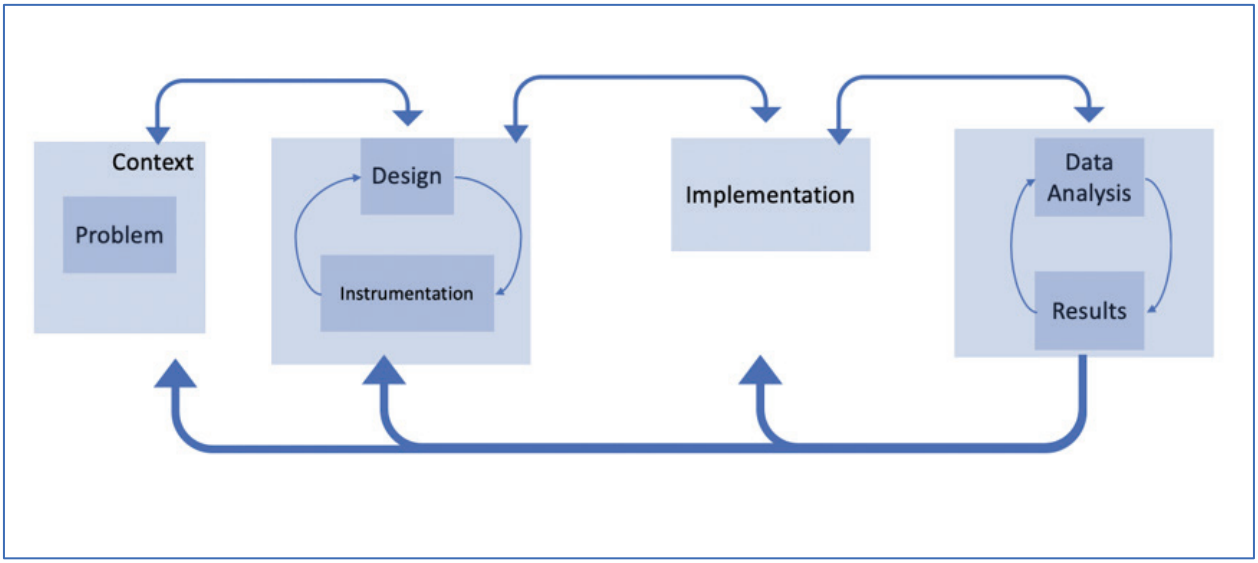
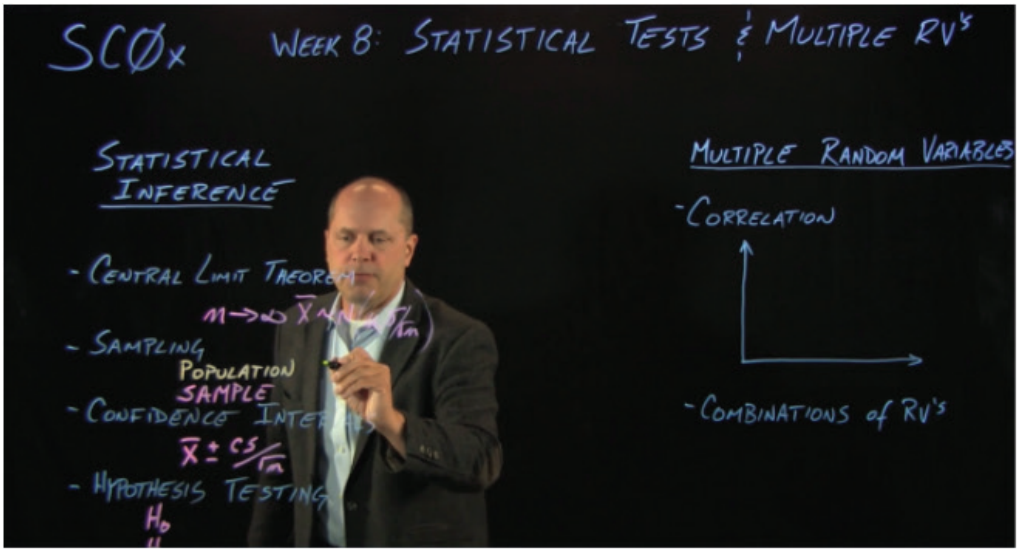
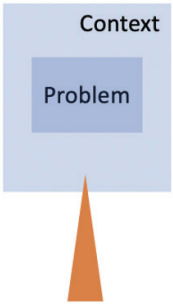
The Learning Engineering Process (Kessler et al, 2020) is operationalized in many different ways within MIT Open Learning. The focus of this case will be on the development, implementation, and iterative next steps of an internal MITx Residential course developed to support the use of the Lightboard lecture capture technology by MIT faculty, instructors, and teaching assistants. The case walks through the different phases of the Learning Engineering process, depicted below.



Before walking through the Learning Engineering process, a quick note about what Lightboard technology is: The Lightboard is a lecture capture system that allows for video capture of an instructor through a transparent glass board as faculty write on and lecture at the board (Birdwell & Peshkin, 2015). The board has LED lights around the edge, so when the instructor writes on the pane with fluorescent markers, the writing "floats" in front of them as they face toward the viewers. The studio(s) which house the system are built and managed by the Residential Education team in MIT Open Learning.



The Lightboard, featuring an MIT faculty member writing on the glass pane during a lecture.



Define the problem to be solved and the contextual setting in which that problem is situated. This should include consideration of the learners, resources, and cultural settings in which the problem will be solved.

Defining the Problem

Problem: Educate faculty, instructors, and teaching assistants on best instructional practices and technical fundamentals of using Lightboard lecture capture technology.

Contextual setting

Instructional approaches associated with the use of Lightboard videos are not particularly new, however, understanding of best practices associated with creating videos is ever evolving (Fung, 2017; Stull et al., 2018; Kessler & Cain, 2020). Despite this evolving understanding, many Lightboard users are mostly unaware of the theoretical and practical underpinnings of effective instruction with a Lightboard.

Even before the COVID-19 pandemic transformed the instructional landscape of MIT in March 2020, the Residential Education team at MIT Open Learning had identified the need to support faculty, instructors, and TAs as they begin their work using the Lightboard studio. While there was a natural interest in Lightboard among faculty before the pandemic, interest that has sprung up since then has undoubtedly been spurred on by this new and evolving context of moving learning to online formats. However, any

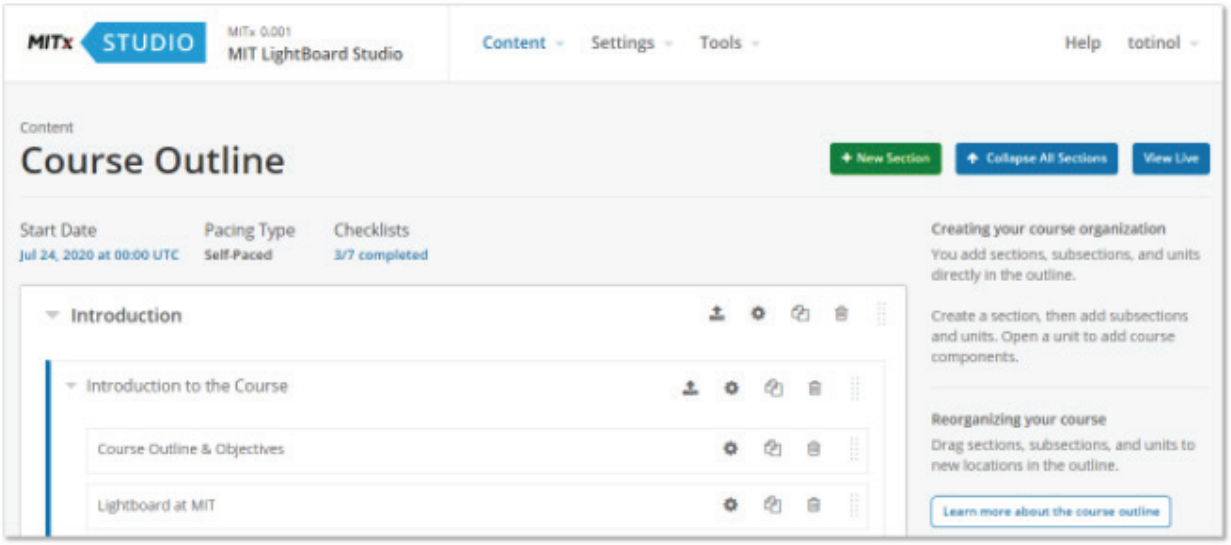
training around the Lightboard would need to exist beyond the emergency situation, meaning that the training content should be broadly applicable and amenable to future use beyond the next few months or years. The transformed instructional landscape of MIT was also an opportunity to bring about a "culture change" around Lightboard use, where the practice of creating perfectly polished lecture videos could be transitioned to creating more authentic ones that would likely end up replacing valuable in-person class time.

Learners

The target learner population consists of MIT faculty, instructors, and TAs who are interested in using Lightboard technology as a tool to teach some content for their courses. While a majority of faculty learners are from STEM disciplines (physics, earth sciences, engineering, etc.), the training course design would need to account for as much variation among faculty as possible, with a focus on making the training inclusive of any faculty from any department who may want to use the Lightboard.

Resources

Residential MITx is MIT's local instantiation of the edX platform that is hosted and supported by MIT Open Learning. The platform offers many of the same features of the Open edX platform while being hosted behind MIT's single sign-on authentication structures. This organization allows only MIT-affiliated users access to the course and was an ideal platform for designing and enacting the short course.

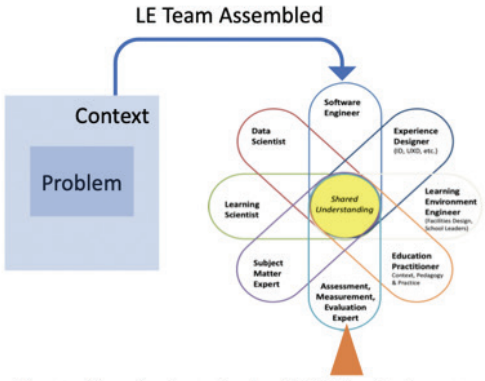


A snapshot of the MITx Studio, the side of the platform where the Lightboard training course was built. This is different from the LMS (Learning Management System) side, which is what the learners see and interact with.

Goals

Having identified the need to support users in developing a stronger understanding of best practices associated with Lightboard instruction, and limited by challenges associated with time constraints and cultural norms around hosting faculty trainings, the MIT Residential team decided the best way to support this work was to create a "short" MITx course. After understanding the problem and all facets of its context, the MIT Residential team established goals for the designing and building this course:

- Introduce Lightboard technology to MIT faculty interested in using it as a teaching tool
- Explain how to use Lightboard in tandem with recommended instructional practices that will allow faculty to create videos that are effective for their students' learning
- Highlight a variety of examples of existing Lightboard videos that the learners' fellow faculty members have created
- Prepare faculty to step into MIT's Lightboard studio(s) on campus and start making videos for their course(s)



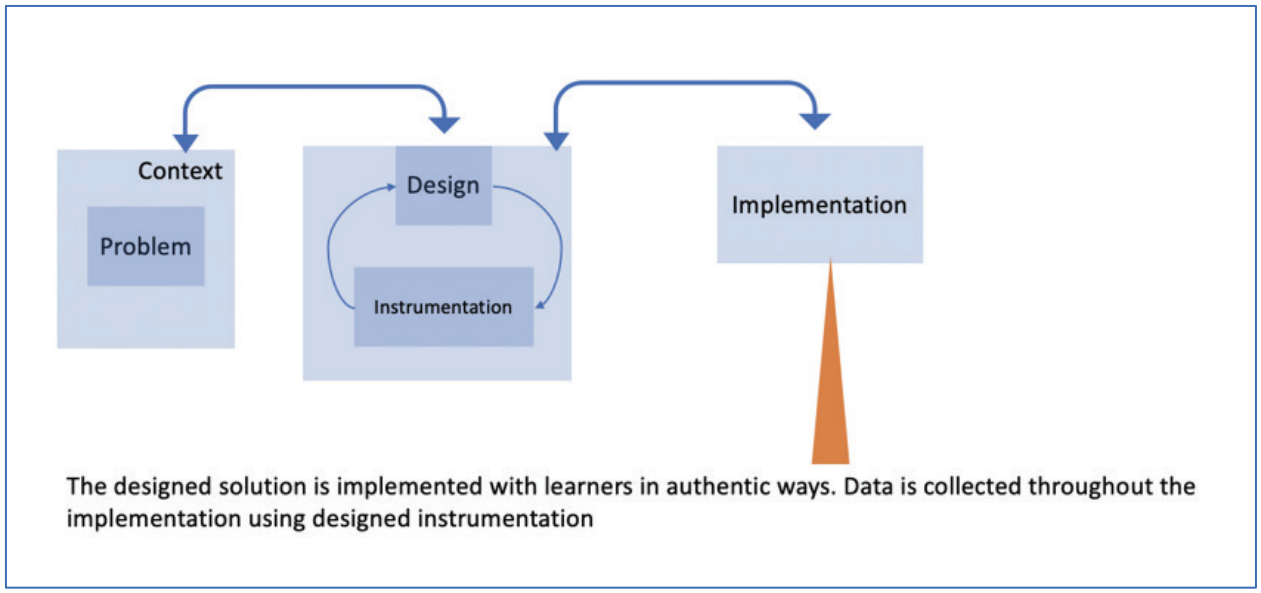
The problem to be solved will dictate the human resources that need to be utilized in during the next step of the process. In some instances problems might be solved by a single person with a broad set of skills. More likely a team of professionals with deep expertise in varying range of areas will need to collaborate in order to design, produce, and implement viable solutions.

Establishing LE Team

The MIT Residential team working on this project comprised of a Senior Learning Scientist, a Senior Education Technology Consultant (ETC), a Learning Engineer & Data Scientist, a Learning Engineering intern, and other members of the greater MIT Open Learning Residential Education team.

- **Senior Learning Scientist:** represents the learning sciences side, serving as a resource for the pedagogical aspects of Lightboard at MIT.
- **Senior ETC:** represents the technical side, serving as a resource for the in-studio experience and best practices regarding planning, presentation, and experimentation with Lightboard.
- **Learning Engineer & Data Scientist:** represents expertise with the course platform, including learner interactions and engagement, and lessons learned from data on these aspects.
- **Learning Engineering intern:** represents the design side – applying the learning sciences, technology, and data to design and build the MITx course (the product).

While the Senior Learning Scientist and Senior ETC had been working on a series of research projects associated with Lightboard usage, the ultimate goal was to leverage the research findings to help support training efforts. Having a LE intern from a local university and training challenges associated with COVID instruction allowed the team a unique opportunity to quickly engineer the course in a way that allowed for rapid adoption.



Design

Research & Exploration

As mentioned in the previous section, there had already been some research conducted on Lightboard pedagogy, which focused on codifying the actions and behaviors of MIT instructors in Lightboard videos to see how faculty develop the capacity to use video capture technology and how that is reflected in their on-camera performance (Kessler & Cain, 2020). This research, as well as the small amount of other existing research on Lightboard pedagogy, is supported by the theoretical frameworks of Cognitive Load Theory, Cognitive Theory of Multimedia Learning (Richard Mayer) and Social Learning Theory. The LE intern examined each of these theoretical lenses to better understand the impacts of Lightboard videos on learning, in order to convey that to the faculty learners taking the training.

Additionally, the LE intern interviewed a Digital Learning Scientist and Lecturer in Physics at MIT who frequently helps Physics department faculty create Lightboard videos. Because she often works closely with a Senior Lecturer in Physics who has been using Lightboard since 2016 and is considered to be a "power user," her insights about the "do's" and "don'ts" of creating Lightboard videos, how to use the studio equipment, and MIT faculty culture helped inform decisions about the content to be sequenced in the course and were additionally very valuable in shaping the language of the training content.

Design Decision Tracking

Based on research about Lightboard pedagogy, technical specifications, and the target learner audience, the team outlined the content that would go in the training course, which was ultimately organized into 4 main sections:

- Unit 1: Introduction (to the course and to Lightboard technology)
- Unit 2: How to Use Lightboard (equipment/workflow and effective instruction)
- Unit 3: Instructional Examples (use cases)
- Unit 4: Additional Resources

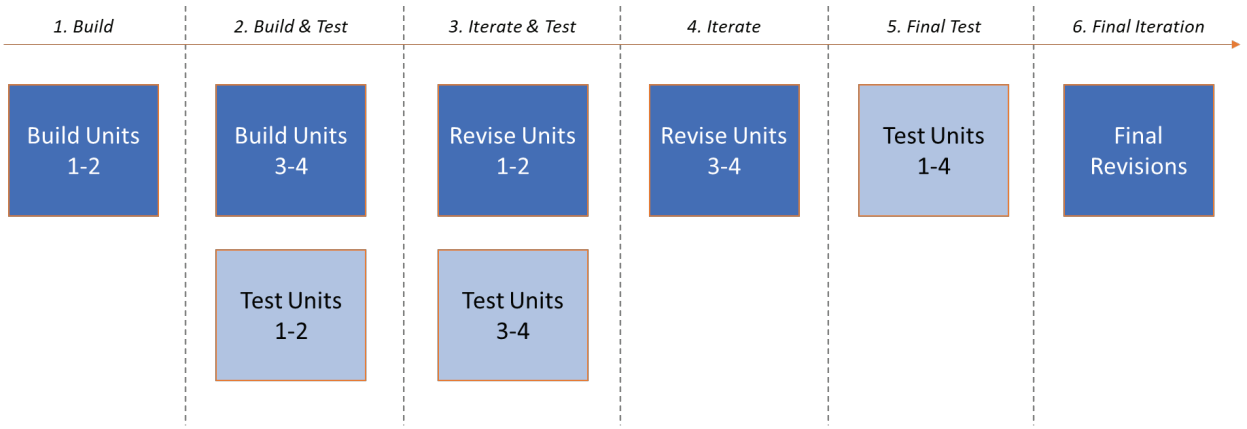
In this way the course content is organized in a sequential order, building on previous content and referencing past concepts and ideas frequently.

As the team worked through decisions about how to design the MITx course, they maintained a design decision tracker with references to design principles/heuristics backed by the learning sciences to help guide the creation of content, media to deliver the content, sequencing, and interactivity in the course. The team also used this tracking system to note contextual and technological constraints to the project. Examples of design decisions that were tracked included:

Design Decision	***Justification***
The organization/flow of the training content will be linear: intro → technical specs & process → best practices & pedagogies → use cases → additional resources	*Based on MITx constraint:* It's challenging to weave content, as MITx is naturally set up to have a linear approach to content delivery. Weaving can mean making links/jumps to other sections, which we want to avoid for a course like this.
To illustrate Lightboard best practices, leverage existing videos featuring MIT faculty in favor of recreating videos, because it is more authentic, engaging, and fosters motivation if the faculty "see themselves" in a variety of video examples.	*Principle of learning:* Learners are more likely to be motivated if they feel capable, know when and who in the world carries out such tasks, and have resources that someone in the real world engaging in that task would have (Goodell & Kessler, 2020)

Building & Prototyping

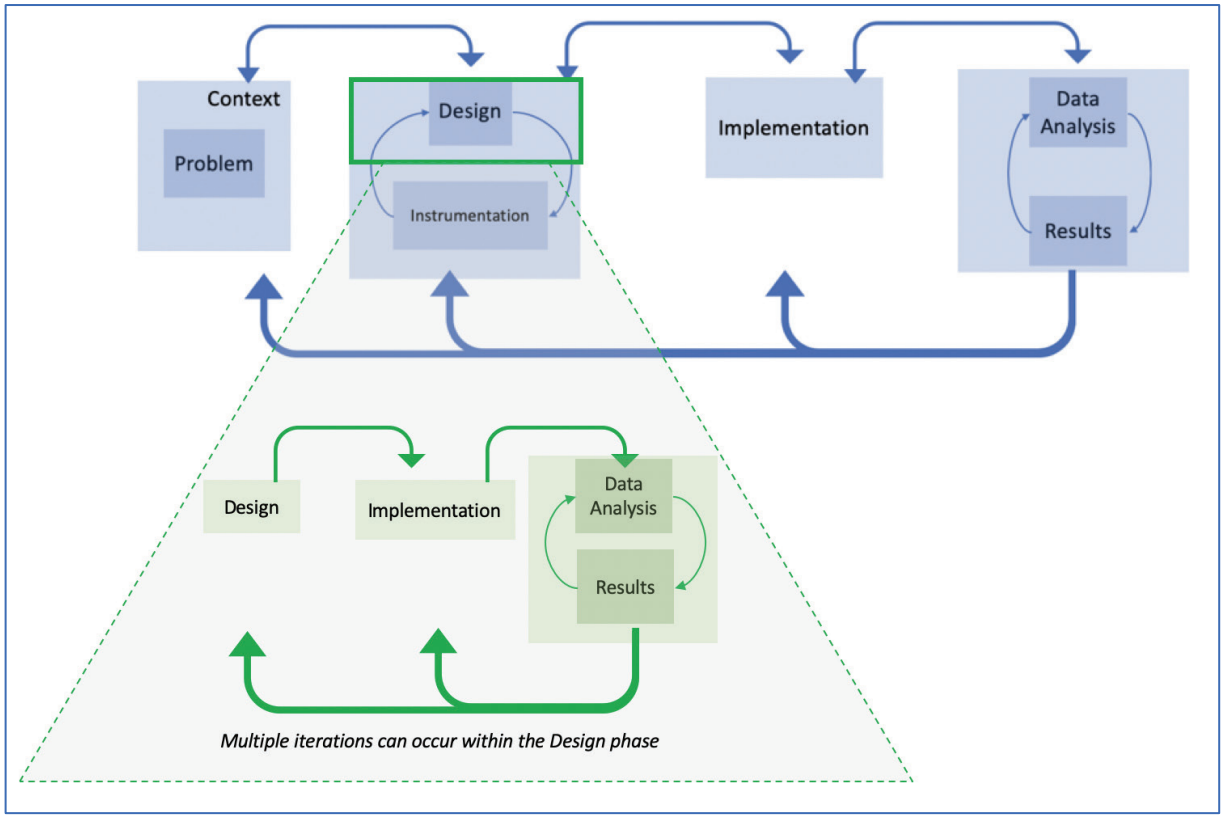
The LE intern built out the course content and features in MITx while the Senior Learning Scientist coordinated a testing timeline and process that integrated with the building process. This approach resulted in collecting a manageable pool of testing feedback and data to complete the initial design and iterate on the work at the same time rather than waiting for the full product to be built before testing and collecting feedback. The visual below depicts how building, testing, and iterating unfolded.



"Mini" Implementation within the LE Process

The integrated building and testing process described above comprised a sort of "mini" implementation of the Lightboard training course in MITx, which was the instrument used to collect data from a preliminary group of testers. Data from this implementation – qualitative feedback from the testers – was used to inform further design decisions and iterations of the course. This process illustrates how

smaller-scale instrumentation, implementation, and data analysis can occur within the design phase, all nested within the higher-level LE process.



Implementation, testing, collecting feedback, and data analysis can occur within the design phase and can result in iterations and new design decisions that feed into the higher-level, or larger-scale, implementation of the solution.

In this case, the higher-level LE process means implementing and collecting data from the real target audience – MIT faculty, instructors, and TAs – about which instructional best practices highlighted in the training they ended up employing in their Lightboard videos for students. In order to inform the design of the MITx course that would eventually be put in front of that audience, the team implemented a prototype of the course and tested it with an audience of MIT Open Learning staff who were familiar with the learning sciences, ed tech, and the MITx platform. Qualitative data collected from this testing effort was simply the first round of iterative data collection and improvement with the internal team. An example of an initial design decision that we iterated based on tester feedback included:

Initial Design Decision	***Tester Feedback***	***Iteration/Improvement***
Team decided not to focus on or create extra just-in-time Lightboard resources in addition to the training course that faculty could reference if they need help once they are in the studio. The audience is comprised of technical	There should be an overall quick start guide and/or checklist of the most important points. The overview of Lightboard studio equipment in the body of the training covers this, but it would be helpful to have a cheat sheet that highlights just the key steps	Team made a "Creating Lightboard Videos: Quick Start Guide" as a PDF linked to *Unit 4: Additional Resources*. The page contains steps to do before going into the Lightboard studio, what to do once in the Lightboard studio, and who to

problem-solvers (by the nature of their work at MIT), as proven by early adopters of Lightboard.	and flow in a concise and handy one-page resource for Lightboard users at any level.	contact for assistance with the tasks that require Lightboard staff. This could be printed out.

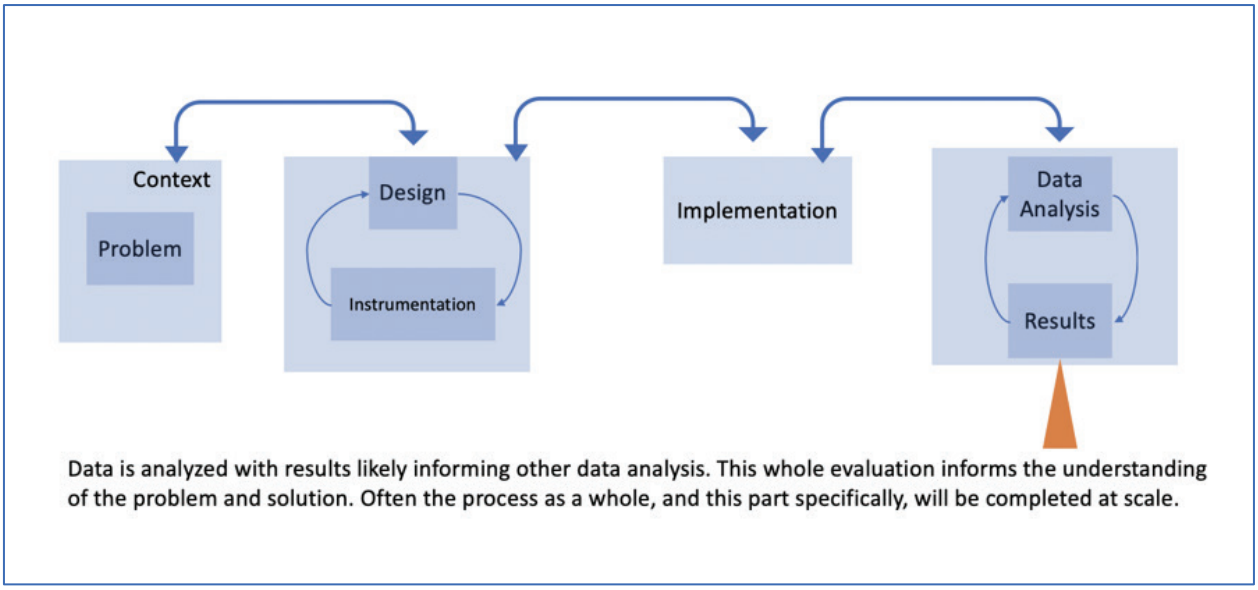
Currently, we are in the second round of improvement that includes collection of data from the slightly upscaled use of the course with MIT instructors interested in using the Lightboard for the first time this next semester. Once we have collected this data, we can make even more informed revision decisions.

Instrument

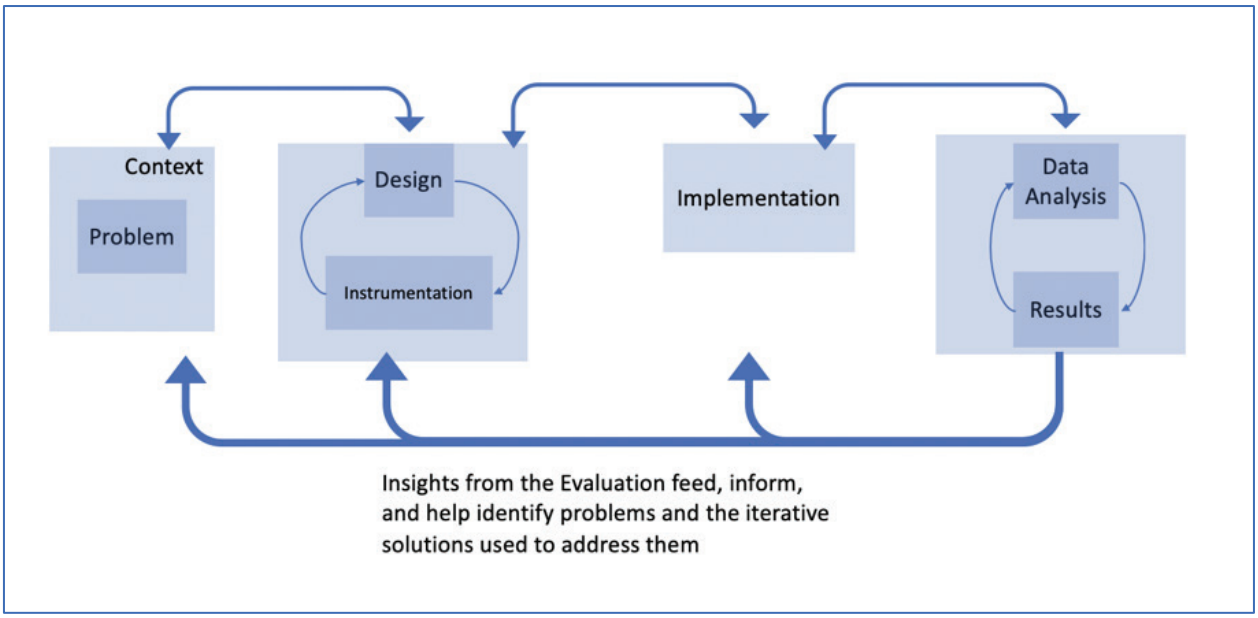
With multiple members of the team having experience using the Residential MITx platform for data collection purposes, and with other research on Lightboard usage ongoing, the instrumentation process relied heavily on previously established indicators of use and movement through the course (video completion metrics, problem attempts & completion, interval analysis between associated platform actions) that could be directly connected with codes assigned to users' Lightboard videos created post training course. These metrics are currently being used to monitor challenging points in the learner experience, better understand the impact on initial instructor videos, and identification of areas for further improvement.

Implement

Due to limited access to campus resources during the COVID-19 crisis, access to the Lightboard studio at MIT is extremely limited with very few new users engaged in the onboarding process as of September 2020. With an increase in capacity planned for winter break and spring term, the hope is that the designed training can be implemented with a more divers set of users soon.



Plan for Iteration



While full scale implementation and iteration of the Lightboard course described above is coming, part of the goal in presenting this case is to highlight the importance of using small scale data collection and user testing as part of the design portion of the LE process. The key to the LE process is that it can be operationalized by many different organizations addressing many different types of problems at many different levels of scale. In presenting one specific instance of this type of work, the hope is that others in the LE community can build on this example and highlight other portions and levels of scale for operationalizing the LE process.

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