Design is (A)live: An Environment Integrating Ideation and Assessment

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Abstract
Design coursework is iterative and continuously-evolving. Separation of digital tools used in design courses disaffects instructors’ and students’ iterative process experiences.

We present a system that integrates support for design ideation with a learning analytics dashboard. A preliminary study deployed the system in two courses, each with ~15 students and 1 instructor, for three months. We conducted semi-structured interviews to understand user experiences.

Findings indicate benefits when systems contextualize creative work with assessment by integrating support for ideation with a learning analytics dashboard. Instructors are better able to track students and their work. Students are supported in reflecting on relationships among deliverables. We derive implications for contextualizing design with feedback to support creativity, learning, and teaching.

Author Keywords
Design education; Iterative Design; Design Ideation; Creativity; Design Assessment; Learning Analytics Dashboard.

CCS Concepts
- Human-centered computing → Interactive systems and tools;
Figure 1 (cont’d).

Students used LiveMâché, a collaborative, multiscale, and free-form system for performing design curation [9].

We integrated submission mechanisms into LiveMâché. Once students join a course, the ‘Submissions’ affordance becomes available (top right: highlighted with dashed orange oval). On press, students see a dialog where they can select new deliverables to submit to and see previous submissions (See Figure 2).

Note: Our IRB protocol enables participants to choose attribution for their creative work, using their preferred name.

Introduction

We develop an integrated design ideation and assessment system and evaluate it in two course contexts. The open-ended, creative nature of design coursework requires students to take risks, sometimes fail, and reflect on how to improve [19]. Design has been identified as an iterative and creative process. A problem and ideas for solution evolve simultaneously: as designers progressively develop and evaluate solutions, their understanding of the problem improves, which stimulates refining and reframing [5]. This constantly changing nature of design makes it a “living” process, with feedback and reflection at its core. In design courses, feedback from instructors guides students towards their next iteration [6], and helps students recognize how
Others perceive their work [15]. As technology becomes increasingly integrated into design and design education due to growing demand, instructors rely more on digital solutions. However, digital submission and assessment systems are often external to the environments in which students perform design. These systems fall short in accounting for the living nature of design, as they only assess a narrow, static aspect of the broader process.

Learning analytics dashboards have proven effective in providing insights into students' work and guiding it [21, 2]. Prior dashboards do not focus on design learning. We develop computationally derived design learning analytics and present those in a dashboard. Instructors can view design work in the same environment in which students create it. This allows them to provide assessment and feedback in-context. Through our investigation, we aim to address two research questions (see left sidebar).

Research Questions

1. How does integrating ideation and assessment affect students' iterative design processes?
2. How does integrating ideation and assessment affect instructors' insights into students' creative design processes?

As part of ongoing investigation into design creativity, we defined design curation, as processes in which designers collect and organize design artifacts to think about, represent, reflect on, perform, and present design processes [17]. One form is free-form curation, which has been shown to support ideation, as students perform creative strategies of collect, assemble, sketch, write, shift perspective, and exhibit [13]. Multiscale design curation emphasizes the contribution of levels of visual scale in these creative processes [17]. We continue developing LiveMâché [10, 9], as a collaborative system for free-form, multiscale design curation.

The present research integrates submission and assessment mechanisms in this design curation environment (Figure 1). Two design courses used the integrated system for a semester: one at KAIST in South Korea; another at Illinois State University in the U.S. Each course consisted of approximately fifteen students led by one instructor.

Figure 2: Submissions dialog: the student selects a deliverable to submit their curation to. They choose whether instructors will see a subarea—i.e., the current view—or the whole curation when they open it from the dashboard.

Related Work

Previous work has investigated assignment submission, versioning, feedback, and learning analytics dashboards.

Digital Submission, Versioning, and Feedback Systems

Digital submission systems in programming courses support instructors in collecting assignments and automatically assessing both correctness and open-ended characteristics such as style [12]. Design work—like any open-ended task—relies on feedback, whether through human or automatic evaluation. Brusasco et al. demonstrated how collecting assignments and providing instructor feedback on students' design work in-context through redlining and commenting is valuable to students [3]. They also allowed stu-
Learning Analytics Dashboards
As more students interact with digital tools, new opportunities arise for using data to give instructors and students insights on learning. Arnold et al. show learning analytics dashboards’ ability to increase student retention, by enabling instructors to construct student action plans [2]. Their study further showed that dashboards increased student and instructor satisfaction, and even prompted students to take initiative in improving their own course performance. Prior dashboards do not focus on design learning.

Further, there is limited prior work in deriving computational insights from design work. CritiqueKit aims to support peer assessment by providing feedback recommendations to design students, based on real-time analysis of students’ review comments [7]. Their study found students were hesitant to use suggestions. It highlights the need for generating contextually relevant insights on students’ design work.

Integrated Ideation + Assessment System
We created mechanisms for students to submit and review deliverables inside the LiveMâché design curation system.

Design Deliverable Submission
When ready for feedback on their creative work, the student, in LiveMâché, selects a deliverable to submit to (Figure 1). They then choose the view of their curation the instructor will first see, upon accessing the submission: either a global overview, or a zoomed subarea (Figure 2). After deliverable submission, student teammates are notified via email. They can view the submitted curation through the submission dialog (Figure 2) or dashboard (Figure 4).

Learning Assessment Dashboard
Fluency, i.e., number of ideas, is a key analytic for assessing creative designs [20]. Prior work assesses both text and
image fluency [14], as these represent complementary cognitive processes, whose combination promotes formation of mental models [8, 18]. For each deliverable, we present instructors with three fluency analytics: word count, image count, and element count, in addition to links to the live design and the latest submission snapshot (Figure 3).

**Instructor Interview Questions**

Q1: How does the LiveMâché course dashboard compare with other dashboards and LMSs?

Q2: Has using the dashboard to follow and track student design processes changed how you interact with students? If yes, how?

Q3: Has the dashboard shown you anything new or unexpected about your students or class or learning? If yes, what?

Q4: How do you understand and utilize the numbers presented on the dashboard with submissions?

Q5: Do the numbers presented on the dashboard support your evaluation and feedback processes? If yes, how?

Q6: What are your suggestions for tailoring the dashboard more to your instruction practices, or design education in general?

In order to understand how integrating the dashboard with curation affects design instruction and learning, we conducted 4 semi-structured interviews: 2 with instructors (D1 and D2) of the 2 courses and 2 with students (S1 and S2). Two authors analyzed the qualitative data, using a grounded theory approach [4], resulting in these categories.

**Integrating Design with Dashboard Supports Iterative Process** Compared to prior learning management systems (LMS) experiences, instructors and students found that the integrated system helps them see the current deliverable in the context of ongoing work, rather than in isolation. D1 felt as though they were part of the students’ ideation process and progress, “kind of like building ideas together”. D1: As the name of the program tells, you’re live...it’s not a fixed and frozen document, it’s still a living thing.

Students reported that the system supported their iterative design processes by enabling them to easily reuse material across deliverables, and reflect on their previous work.

S1: [Previous LMS was] only for uploading the files I made in...other software. LiveMâché is literally live, I could perform creative work and submit it.

At the same time, both instructors and students felt that traditional LMSs offered more features for managing administrative functions of the class. For example, D2 suggested that “it would help [if the system] supports keeping track of deadlines.” Students echoed this need.

**Instructors’ Assessment and Feedback to Students** Instructors report that automatic access to student work, on submission, streamlines design assessment and feedback.

Previously, students often forgot to grant instructors access rights to submissions—despite instructions—delaying feedback. Instructors want students to submit work early, in advance of deadlines, and then continue to iterate, enabling
more feedback. Submitting creative work early for contextual feedback represents a new user model for design.

D2: Being able to see how their processes evolve has been helpful for me...in seeing how much they actually learned.

D1: I expected them to submit sooner, so that I could provide feedback before the class.

D1 suggested that the ability to notify students when feedback is left on their designs—and being notified when students resolve that feedback—would be helpful. D2 subsequently expressed interest.

D1: [Notifications on feedback] are critical because even though I provided comments...to [designs] submitted earlier, [before] the deadline, [students] had no idea I had provided feedback. I kind of [want] my students to respond to my comments right away [and at] an email notification [when students resolve feedback].

Computational Derivation of Analytics from Design Work
Instructors report that while the analytics do not indicate the quality of a design, they provide insight into students’ effort across certain dimensions. D2 expressed that visualizing changes in analytics over time would be useful.

D1: I think it showed me this student worked hard, they did a lot of research...[but] it’s challenging to see numbers and somehow assess the quality of work.

Both instructors desire advanced analysis of student design work, in particular, presenting conceptual ideas present in students’ design.

D1: Numbers are nice, but things like a word cloud would be helpful.

D2: I would like to see how we can analyze the images...Though whatever the computer reads is different from the designer’s aspect.

Implications for Design
Systems that integrate ideation and assessment, by contextualizing deliverables, mutually support instructors and students in design education. Their understanding of design processes and progress becomes enhanced. As S1 articulated, “what worked, what didn’t work, what was hard, and what their process was.”

Design is alive: as a process. The dashboard keeps a link to the live submission available to instructors, facilitating ongoing feedback. In support of design’s living nature, students and instructors benefit from integrated systems that contextualize creative design work with assessment. As part of this, build systems that enable instructors to leave feedback on designs and notify students. Close the loop by notifying instructors when students address the feedback.

Design education will benefit from extending AI-based content recognition techniques [1, 16] to perform computational analysis of design work [11]. Instructors said design analytics provide insights into student work, across dimensions.

Future research needs to investigate, in-depth, how instructors evaluate student work, to guide computational modeling of their approaches. As D2 expressed, “whatever the computer reads is different from the designer’s aspect.”

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