Educational Software Design in Practice: Understanding the Power of Intersecting Disciplines on Design Process through an Autoethnographic Approach

Conference Paper · July 2018

CITATIONS
0

6 authors, including:

Umair Sarwar
Purdue University
4 PUBLICATIONS **1** CITATION
SEE PROFILE

Iryna Ashby
Purdue University
27 PUBLICATIONS **33** CITATIONS
SEE PROFILE

Mohan Yang
Purdue University
4 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Brantly E. McCord
Purdue University
3 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Educational Software Design in Practice: Understanding the Power of Intersecting Disciplines on Design Process through an Autoethnographic Approach

Abstract

This chapter shares the co-authors' evolving understanding of design process in an interdisciplinary environment, shaped by unique individual backgrounds and shared engagement in an interdisciplinary educational software design course from both the instructor and students' perspectives. Following a collaborative autoethnographic approach, we examined our autobiographical narratives and dialogic conversations to make meanings out of personal stories, and developed a collective vision of how the course design impacted our understanding of design process. We will discuss implications on the design of interdisciplinary courses.

Educational software design requires an interdisciplinary approach combining theories of learning and engagement, accessibility, and design (Tchounikine, 2011). It requires collaboration of professionals with diverse backgrounds, including instructional design (ID), user experience design (UX) and software design. While these specialists are steeped in disciplinary perspectives, theories, terminology, and processes (Exter & Ashby, 2018; Tchounikine, 2011), educational programs do not necessarily prepare them to understand what other specialists do and how they do it.

Design connotations differ across fields, as do the formal process models used. Process models visualize intangible steps to explain design aspects and improve them based on iteration and subsequent implementation (Orbus Software, 2016). A clear path offered by a process model provides better time and process estimates, keeps a customer updated, identifies potential challenges and addresses them early (Segue Technologies, 2015). **[If sufficient space in later drafts, we will discuss specific process models drawn from examples used in this paper]**

Learning in an interdisciplinary environment exposes students to 'different kinds of knowing' (Davies & Devlin, 2010), but efforts to embed interdisciplinarity in higher education have often been challenging (Gillis et al., 2017; Jones, 2009). This chapter focuses on the experiences of graduate students in one interdisciplinary graduate course. We will examine the impacts of our unique disciplinary backgrounds and interdisciplinary course experiences on our thoughts about design and design process. This is a later incarnation of the course described by instructor Marisa Exter and an earlier group of students (Exter et al., 2018).

To tell our story, we use a collaborative and evocative autoethnography approach, where authors are "simultaneously the instrument and the data source," in order to capture the meanings of the collected personal experience (Chang, Ngunjiri, & Hernandez, 2012, p. 22), valuing the analysis of self to ensure intersubjectivity (Chang et al., 2012). We combined co-review of artifacts, dialogic conversations to elicit and discuss our experiences and lessons learned, and

expanded these ideas into writing through individual responses to prompts (see Fig. 1). Throughout the chapter you will hear individual voices of the instructor and students. Reflexivity was built into the whole process: from dialogic conversations to the narrative write-up. We each recognized our positionalities within the process and with each other and worked on maintaining an open dialogue (Anderson, 2006; Palaganas, et al., 2017).

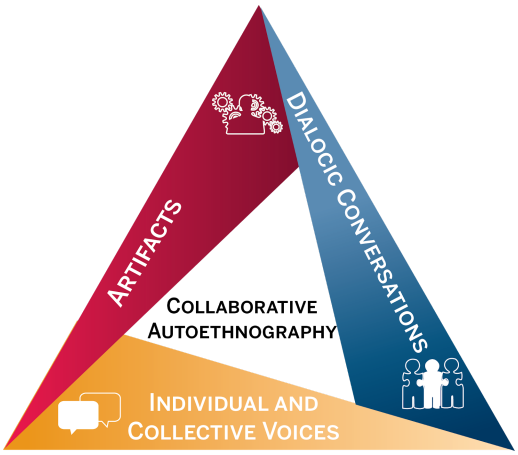


Figure 1. Triangulated data resources.

The Co-Authors

Figure 2. Authors' profile

About the Course

Educational Software Design (ESD) is a studio-model, semester-long interdisciplinary graduate course centered around an authentic client-proposed team project.

Marisa: I have had the opportunity to work on and lead a multidisciplinary team including instructional designers, software developers, UX designers, and graphic designers. My research focuses on competencies needed by educational software designers, computing professionals, and instructional designers. Across these studies, "professional skills" and ability to work as a member of a team of diverse specialists were consistently found more important than technical skills.

Reflecting on my own education, I recall little explicit scaffolding to help bridge what was learned across liberal arts disciplines, and no attempt at all with other professional domains. Most of my research participants indicated a similar lack of experience with either content from other disciplines or students from different disciplinary backgrounds.

This inspired the ESD course, which aims to help students build understanding and respect for future colleagues as well as the ability to quickly build a working relationship with them by exposing them to the terminology, techniques, and processes used in other disciplines within an authentic project-based experience to give them a sense of how interdisciplinary projects play out over time.

Shifting Understanding of Design Process

To discern how students' understanding of design and design process evolved, we discussed how we thought about this before and after the course.

Before the course: Our thoughts regarding design process coming in varied based on our individual disciplinary backgrounds.

Brantly: Perhaps unexpectedly, my experiences in a variety of fields led me to believe that the design process was input-output: a tech-based problem deserves the iterative design process model, which would act differently than an ADDIE approach or the scientific method.

Mohan: As a novice designer, the training I've got so far is relatively rigid following sequential stages from Analysis to Evaluation though there are flexible and iterative models in my field which seems to fit experts from my perspective. My design mindset was still characterized as rigid and linear before the course.

Tadd: My background in instructional design exposed me to more of the linear, classical models that are common in ID programs.

Umair: No such thing as the word "design process" existed in my dictionary of terms. The term used in engineering is design methodology and each is an approach that is defined by a main basic step. In some, Quality Function Deployment is the main core of the step while another design methodology might focus on techniques ...to generate hundreds of ideas, each highlighting different features …. and then use concept evaluation and selection techniques to really pick out the innovation in the various designs and come up with the best hybrid version.

End of course: We developed a shared understanding of design process that included such key aspects as flexibility, iteration, goal-orientation, and adaptivity to the needs of particular problems. However, we still retained some of our original ideas of what design means within our individual disciplines.

Brantly: Design process is the flexible methodology that guides a project through tried-and-true stages of development, often synthesized from both personal experience and process models. Personally and interpersonally biased, it can be shaped situationally.

Mohan: It can be iterative or rigidly sequential depending on the tasks, resources, and people I work with. If I have to give it a definition, I would view it as an adapting problem-solving process.

Tadd: A design process is used to create something of value and worth through a series of steps including identifying an issue or problem, gathering relevant information (about the problem, people, or possible solution/prototype), conceptualizing and designing possible solutions, and managing the associated workload and available resources. This process can be explicitly created and followed, or it could be internal to the individual or group and proceed innately.

Umair: If there is one thing that we follow in our design process, that is iteration and there is no fixed pattern. Each design process for a product is dominated by the type of product you are designing and who you are designing it for. [Designers need to be] open to iterate and use any tools you deem necessary and seem appropriate according to the type of product.

Multifaceted Field of Design

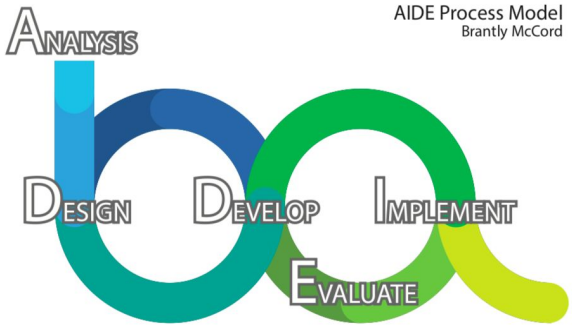
As part of the course, students had a chance to explore, align, and potentially synthesize process models that would best fit the design and development process in which their team engaged.

Marisa: My experience learning about instructional design often seemed to leave software development, UI development, graphic design, animation, video production, etc. to fit in "development" - a black box where all this work happens. Yet, specialists all have their own process starting with analysis and ending with unique types - and purposes - of testing. It makes no sense for these individuals to sit around waiting for an instructional designer to tell them what to do. This lead me to feel that the ID models and other discipline-specific models are not only inefficient and potentially somewhat ineffective, but also lacking in understanding - and perhaps even respect - of the work done by others.

Students' Perceptions: When asked to create our own visions of interdisciplinary team design processes mid-way through the course, our visualizations demonstrated how conversations and experiences within interdisciplinary teams had shifted our thinking.

Brantly: My partner and I didn't talk much about the process in formal terminology unless we were particularly talking about the assignment descriptions or class discussion boards. Personally, I didn't want to stifle my partner's thoughts and action on the project, so I tried to focus on what needed to be accomplished, not when/how to accomplish them. In retrospect, the process seemed to resemble the iterative ADDIE models we formed in an exercise mid-semester, but it was more like our actions fulfilled the model, not the other way around!

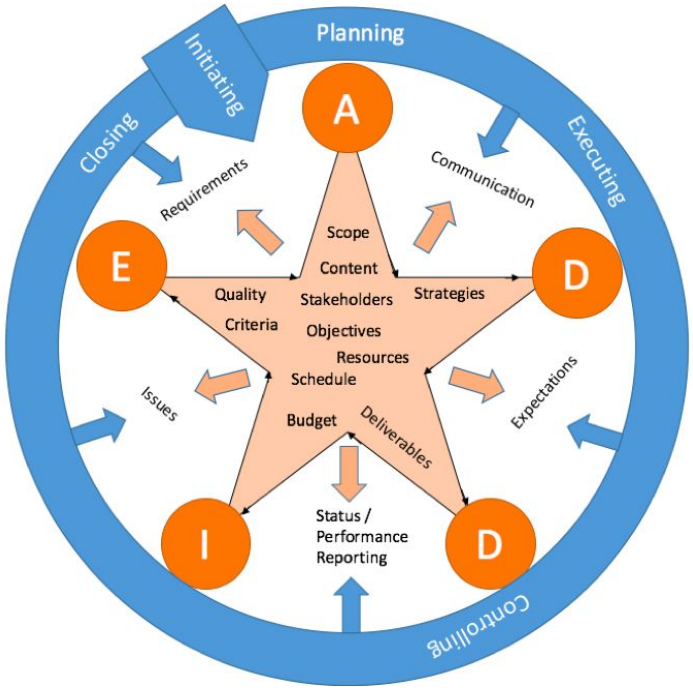
Influenced by his partner and the course structure, Brantly combined ADDIE and quasi-Agile model in his visualization.



Mohan: I could really perceive the value of the different design thinking my partner brought in to our team. His insights in game design played an important role in our final solution. We talked through the design ideations, technology tools from both disciplines in both class discussions and private weekly meetings. The final

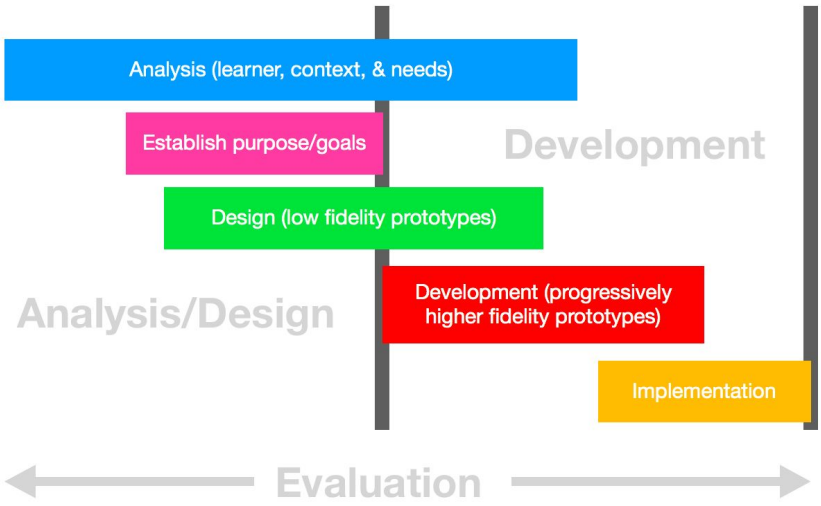
process reflected the characteristics of both instructional design and game design disciplines.

Mohan combined project management and ADDIE to address the undefined project nature within each iteration.



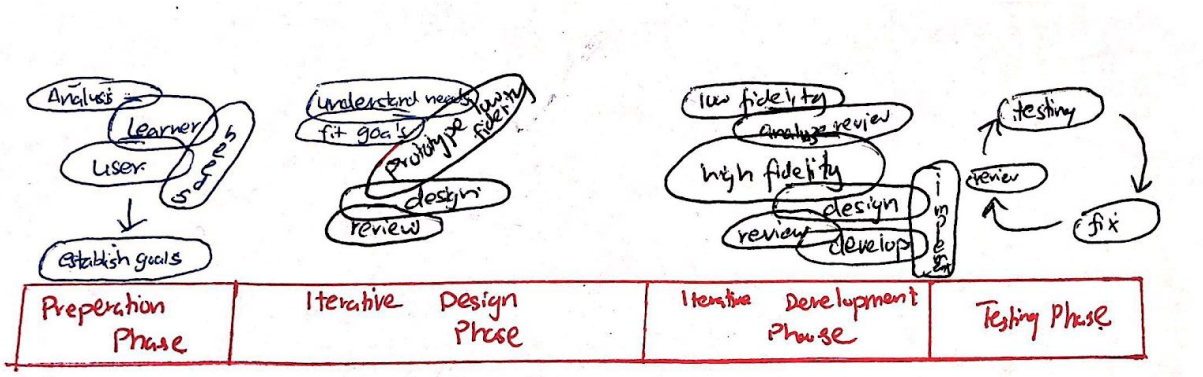
Tadd: We were pretty interdisciplinary which I believe was a great strength. Our machinist and aviation team member were experienced in the content area since we were building a product for an on campus machine shop. Our UX designer really did most of the interface design with her expertise. I completed a lot of the analysis with my background in instructional design. We created a process model as a team although most of the time the process was driven by the course requirements, and we basically "divided and conquered" assignments by our areas of expertise.

Although Tadd did not think they followed a model exactly, he merged ADDIE with the rapid prototyping model (Tripp & Bichelmeyer, 1990) to describe the team process.



Umair: Negotiating with interdisciplinary teammates in a design process is a really unique experience as everyone has a perspective to offer from their background and do thing there way. I think an interdisciplinary team brings the idea of design in play into its fullest- the way you iterate in design, working with with interdisciplinary team is like that. You keep changing and working amongst each others ideas until you reach to the right point.

The process model he presented combined several models including SAMR, Modified Waterfall, and the ADDIE model.



Impact of Course Structure and Feedback on Design Process

Marisa: I wanted students to be iterative and flex on the structure of the class in a way that would work for a given project - and I told students up front that they could "negotiate" with me on due-dates etc. I really want to push towards rapid prototyping. However, I also wanted to give them the chance to create analysis, design, and evaluation documents similar to those used in ID, SE, and UX… and

we had to have some sort of deadlines and the course schedule looks linear. So it's a real design tension.

Student's Perceptions: We perceived the course as following a linear process, and each team seemed to respond to it differently.

Brantly: Since out-of-class assignments were designed around the linear ADDIE format, we hesitated to deviate. As someone unfamiliar with ADDIE before, I'm glad I learned it now: I feel as though resting on an Agile or iterative workflow would've launched us into the work without enough proper foundational analysis.

Mohan: In the overarching sequentially structured course process, different elements and perspectives from other fields were also incorporated by the instructor, including multiple design models, design ideation, usability testing, etc. However, despite the guidance we received from the class structure, we were sometimes constrained by it to move forward to save time for iterations.

Tadd: Because our project was well-defined from the beginning, we were already at a different place in the design process when compared to the other groups with projects that were less developed. We felt like our design process should have progressed more quickly through the earlier analysis stages than what the class permitted. It was common for us to leave a team meeting or a meeting with a client with a clear vision of what the next steps for our design should be but felt the need to "slam on the brakes" and return to the analysis stages to fulfill the course assignments. At the end of the course, I felt like we could've given our client a product that was more complete and well-developed if we been able to progress with more freedom and flexibility.

Umair: The class structure was set in way that kind of enforced the design process but then there was enough liberation to really explore the design process on its own. It gave you a guideline on how to process by equipping you with the tools but like our group, the project was so open ended and vague that the class structure gave us ability to perform. The flexibility enforced deadlines really helped guide the design process from the outside but inside the team, it was moldable as needed to include personal elements related to the projects and work on a case by case basis.

Use of Critique

Marisa: Critique is part of the studio model, and in earlier iterations of this class I used it mostly to give feedback on early designs, as well as providing experience with giving and receiving critique. As I tried to move the class towards a rapid prototyping approach, I tried to use critique to push students to keep returning to analysis (something they typically don't like or see the need for) and ideation before settling on a design.

Students' perceptions: We all found critique valuable, but not necessarily in all the ways Marisa intended.

Brantly: I feel as though our team walked away from every single critique with a new focus on our project, in a good way. We'd receive new insight that we couldn't have formed on our own, thanks to the interdisciplinary spread of our class. The engineers, for instance, would be confused by storyboards that made plenty of sense to UX designers, enabling us to accommodate more minds.

Mohan: Most of my impressions on the critique are highly positive with occasional feeling of being overwhelmed. Our project started as being very broad and the classroom critique from both the instructor and peers really helped us to be more focused. However, because of the rigid stages of the class structure, we spent tremendous time on each stage, while sometimes the feedback on our deliverables indicated the necessity of major revisions, which really frustrated me. In addition, sometimes the feedback from the critique conflicted with the information we got from target audience, and that made us question the critique a little bit. I believed that we should be critical in receiving the feedback.

Tadd: I'm a fan of feedback because I think that it breaks you out of your own limited perspective to see your product or design from the perspective of others. Peer feedback in this project was really helpful because it pointed out possible issues, problems, or gaps we may have overlooked, provided us with additional ideas for improvement, and pointed us to resources that may help in our process. The problem we experienced was not with feedback itself, but with the course assignment which required us to document and respond to each piece of peer feedback we received.

Umair: Classroom critique was a much more useful tool in the design process as you could explain and more like talk it out with the teaching staff. The critique we feel was targeted more towards the elements inside the design process rather than the process itself. That was particularly, because we as a team were not sure

what we were really doing due to the conflict of interest between the client, us a team and elements of the class.

Impact onto the Future

Participating in the interdisciplinary course impacted our understanding and changed our approaches towards applying design thinking.

Brantly: As a game development instructor, I've cemented my belief that interdisciplinary experiences allow a project to thrive. I've taught students to design games from outside the bubble of "video game design" itself ("How does an architect make a building easy to navigate?"), but now I further understand how *participating* in processes from another field can improve one's range of sensibilities. Things like functional requirements from software development are now something I introduce to my students, which may not have fit into their agile mindset before; solutions are out there, beyond disciplinary boundaries.

Mohan: Besides the different design models and processes, the perspectives and experience of my peers who came from different disciplines including aviation, engineering, user experience and computer graphic are all valuable to me. People from different fields approach tasks differently. Design with an interdisciplinary thinking is something I strongly believe now for better solutions to support teaching and learning in a more effective and efficient manner.

Tadd: I think it's important to use a process that is flexible and open to change. There are so many factors that come up during that process, and holding true to a process model may not only be impractical but may ultimately hinder the success of the design. I also think that having an interdisciplinary teams is helpful in designing a process model because many of our projects are interdisciplinary in nature and we need to have tools and processes that match the character of what we design.

Umair: My teaching style has been impacted greatly by this class- the biggest impact being the introduction of scenarios in personas and using a modified design process. In engineering, typically iteration is done in a single phase. For example, if you are in the drawing phase, you assume everything done before is correct and iteration is only needed in this part. The phases are not interconnected. The biggest impact I have taken from this class is that design process is about iteration amongst phases. That model is something that I am reflecting upon during my teaching.

Conclusion

Our individual stories and reflexive discussions provided insights into the way students from disciplinary programs viewed design process and how these views shifted in an interdisciplinary environment. Although this paper focuses primarily on process, the implications of our discussion impact the way we see the course as a whole.

[In a later draft of this paper, if we have sufficient space, we may also discuss impacts of what we learned on the course redesign for next year.]

References

Anderson, L. (2006). Analytic Autoethnography. *Journal of Contemporary Ethnography. 35*(4), 373-395.

Allen, W. (2006). Overview and evolution of the ADDIE training system. *Advances in Developing Human Resources, 8*(4), 430-441

Chang, H., Ngunjiri, F., & Hernandez, K. C. (2012). *Collaborative autoethnography.* Retrieved from https://ebookcentral.proquest.com

Davies, M., & Devlin, M. (2010). Interdisciplinary higher education. In M. Davies, M. Devlin, M. Tight (Eds.) *Interdisciplinary higher education: Perspectives and practicalities (International Perspectives on Higher Education Research, Volume 5).* Bingley, UK: Emerald Group Publishing Limited (3 - 28)

Exter, M., Alshammari, A., Fernandez, T., Randolph, A., Chartier, K., Kuo, Y., Lancette, S., & Nemelka, B. (2018). Empowered guinea pigs: Stories of cross-disciplinary projects in an experimental educational software design course. In Hokanson, B., Clinton, C. & Kaminski, K. (Eds.), *Educational Technology and Narrative* (165-176). Cham, Switzerland: Springer.

Exter, M., & Ashby, I. (2018). Preparing Today's Educational Software Developers. *Journal of Computing in Higher Education.* DOI: 10.1007/s12528-018-9198-9

Gillis, D., Nelson, J., Driscoll, B., Hodgins, K., Fraser, E., & Jacobs, S. (2017). Interdisciplinary and transdisciplinary research and education in Canada: A review and suggested framework. *Collected Essays on Learning and Teaching (CELT), 10*, 203-222

Hooper, S., Rook, M., & Choi, K. (2015). Reconsidering the design of a learning design studio. In B.Hokanson, G. Clinton, & M. Tracey (Eds.), The design of learning experience: Creating the future of educational technology. New York, NY: Springer.

IDOE Design Kit. (n.d.). *The field guide to human-centered design.* Retrieved on January 31, 2019 from http://www.designkit.org/resources/1

Jones, C. (2009). "Interdisciplinary Approach - Advantages, Disadvantages, and the Future Benefits of Interdisciplinary Studies," ESSAI: Vol. 7, Article 26.

McConnel, S. (1996). *Rapid Development: Taming wild software schedules.* Redmond, WA: Microsoft Press.

Nurkkala, T., & Brandle, S. (2011). Software studio: Teaching professional software engineering. *SIGSCE '11,* Dallas, Texas: ACM. (pp. 153–158).

Orbus Software. (2016). Retrieved from https://www.orbussoftware.com/resources/videos/bpmn-distilled/benefits-of-process-modeling/

Palaganas, E. C., Sanchez, M. C., Molintas, M. V. P., & Caricativo, R. D. (2017). Reflexivity in Qualitative Research: A Journey of Learning. *The Qualitative Report. 22*(2), 426 - 438.

Segue Technologies. (2015). Retrieved from https://www.seguetech.com/benefits-adhering-software-development-methodology-concepts/

Smith, K. M. (2008). *Meanings of "design" in instructional technology: A conceptual analysis based on the field's foundational literature*. *Instructional Systems Technology*. (Doctoral dissertation, Indiana University, Bloomington, Indiana.)

Tripp, S. D., & Bichelmeyer, B. (1990). Rapid prototyping: An alternative instructional design strategy. *Educational Technology Research and Development*, *38*(1), 31–44.

Tchounikine, P. (2011). *Computer science and educational software design: A resource for multidisciplinary work in technology enhanced learning.* New York, NY: Springer