

Contextual Inquiry, Participatory Design, and Learning Analytics: An Example

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ABSTRACT: The methods used in learning analytics for early specification of design requirements are still generally grounded in prior research, theoretical frameworks, and the existing body of practice. These traditional methods provide a strong background for development, but adapting them to a wide range of user needs is challenging. Participatory design and contextual inquiry can address this challenge. These user-centred design methods help extend theoretical principles into real-world applications. As such, we propose field-based contextual inquiry and participatory design methods to elicit design requirements for learning analytics features and present an exemplar study as a starting point for future exploration and validation of these approaches.

Keywords: Contextual Inquiry, Participatory Design, Learning Analytics, Learning Dashboards

1 INTRODUCTION

Participatory design (PD) integrates users into the technology creation process through a variety of methods (e.g., interviews, observations, or design activities; Muller, 1993, 2003) to elicit requirements from the early stages of the design process. Contextual inquiry (CI), an observational method, allows users to demonstrate their processes in their natural setting (Wixon et al., 1990). Like in PD, a key component of CI is the partnership between the researcher and participant where the researcher acts as apprentice to the participant who is a master of his/her process (Holtzblatt & Beyer, 2012). CI is a method that draws significantly from ethnographic studies and can be applied as part of the task analysis stage of any software development process. In such stages, the researcher aims to uncover users' existing practices, processes, beliefs, or use of artefacts to identify opportunities to improve upon existing tasks or to specify requirements for new technology that are better grounded in user needs. This gives researchers an accurate and thorough understanding of the activity, including important details that may be overlooked when other methods are used. PD and CI can also reveal hidden elements of user's mental models that result from the difficulty associated with verbalizing one's process. Moreover, they can empower students to take ownership over their learning (Birch & Demmans Epp, 2015), which is atypical when other methods are used.

Current educational technology contexts reinforce existing power structures, which can contribute to adverse consequences (Avison, Baskerville, & Myers, 2001) that include the ignoring of provided analytics (Ferguson et al., 2016) or their misinterpretation and misuse (Demmans Epp & Bull, 2015). At present, CI and PD are rarely used despite their potential to inform design by better understanding learners and their environments. This potential along with a need to make learner

decision-making processes explicit makes these methods crucial for designing better analytics, streamlining the design process, generating novel insights, and increasing learning analytics adoption in ways that traditional methods have not. This paper presents an exemplar study that takes these first steps.

2 CURRENT STUDY

Adult English Language Learners (ELLs) require strong writing skills to improve their work and social opportunities. In traditional classrooms, resource constraints make it a challenge to consistently provide timely and personalized feedback that support writing development. We are building a mobile application to support the writing development of mature ELLs (Age: $M = 40.1$, $SD = 9.2$). This study applies CI and PD guidelines to the task of designing an application that addresses the unique needs and challenges of this group of learners. We have designed and conducted a field study with 15 mature ELLs who are recent immigrants to Canada. In the first two sessions, participants completed writing samples, peer-reviewed other participants' writing samples, and participated in a one-on-one interview that explored their writing challenges and needs. The third and final session is currently underway. It consists of focus groups where ELLs actively engage in application design to generate guidelines and feature ideas for the tool through discussion, scenario-based prompts and sketching activities facilitated by the researcher. Instruments, like the Motivated Strategies for Learning Questionnaire (MSLQ), provided insight into participants' goal orientations, motivations, and beliefs. Observations of participants' writing tasks and interviews provided complementary information.

Below, we outline the advantages of CI and PD as we enacted them within this study. We explore how involving learners throughout the design process generated context-relevant insights that supplemented the results obtained through traditional methods. Some of the observations from the first two sessions are shared. We then discuss how the early incorporation of CI methods shaped the design of the focus group and the PD activities that occurred during the third session.

2.1 Advantage one: Provides context to empirical findings

Prior work stresses the importance of completing CI observations before introducing the idea of new technology (Axtell & Munteanu, 2017). This prevents participants from fixating on technology limitations or wondering how their performance will affect its design, and it helps prevent imposing pre-defined structures on analytic design. The first research objective was to study writing practices. Once these practices were understood, the next objective was to design a tool that supported natural writing flow. The CI used consisted of direct observations of participants' writing tasks and their use of help tools as well as questioning them about their workflow (when appropriate as to not disturb writing flow).

When performing peer-review activities, four ELLs were seen using their phones to translate words. When questioned, most said something similar to "I can improve my vocabulary because for the first one I think some of his words I even don't know. And I look up in my dictionary. I think it's better for me to improve the vocabulary." While ELLs understood the objective of peer-review was to provide feedback, they also viewed it as an opportunity for advancing their own learning. High MSLQ scores for both intrinsic goal orientation ($M = 6$, $SD = 0.6$ out of 7; how motivated learners are by internal

factors) and task value ($M = 6$, $SD = 0.8$; importance of mastering a learning activity) were consistent with this participant claim. Observing ELLs as they performed learning activities allowed us to capture how their beliefs and motivations manifested into practice, which informed the tool's design. For instance, we could provide features to support ELL learning of unfamiliar words to expand their own knowledge as they engage in peer-review.

The interviews also revealed that many ELLs had minimal instruction on writing. For almost half, neither early schooling nor their English classes emphasized writing, as one participant shared:

They didn't say about how to write the essay. Just our teachers said: 'You have to write three paragraphs, one paragraph about your opinion. The second paragraph it means the body, and the last paragraph you have to describe the conclusion.'

This finding was validated by an ELL instructor hired to grade the essays, who found the participants had little understanding of essay structure. In this case, combining existing practices (skill assessment) with interviews provided deeper understanding of barriers faced by ELLs, namely a systemic lack of instruction on core writing fundamentals.

2.2 Advantage two: Shines light on hidden assumptions

When asked what makes a "good" teacher, ELLs emphasized the value of praise. As one said, "It's positive. It is like the motive to continue writing because you're receiving a good feedback. Someone is praising you." Others felt unwarranted praise should not be given: "My teacher was saying all the time for me: 'oh you're doing well'. I will say: 'No, that's bad look at how many mistake' ... the moment he starts saying to me 'good' that was like saying 'very bad'." This variability highlights the importance of involving learners in the design process and avoiding letting "common sense" guide design. This variability in learner personalities cannot always be captured with traditional, empirical methods. When designing technologies for real-world adoption, it is important to design for the spectrum of learners, not the average.

Beyond this, our ELLs had strong beliefs about what comprised good feedback. They had many follow-up questions on feedback they received. Their ability to articulate the feedback they wanted prompted us to reflect on our app's structure. In the initial design, writers had no direct communication with their peer-reviewer. The peer-reviewer communicated through predefined rubrics. ELLs' clarity suggested they may benefit from more direct communication with reviewers. One design to help learners access this feedback is to allow them to submit questions to guide their reviewer's assessment.

As seen here, combining results from CI with traditional assessments can provide additional insight. One major advantage of integrating both approaches is that it provides both an objective view of the learning context and the learner's perception of it. This can highlight surprising (in)consistencies between the two. Another advantage of CI is that it can help generate design ideas.

2.3 Advantage three: Identifies limitations of existing technology

Initially, a desktop app was envisioned, like most learning-to-write technologies (Schunn, Godley & DiMartino, 2016). However, interviews with the learners revealed several assumptions made by

these applications that did not apply to these learners and that were not captured by the psychometric scales. First, these apps assume an instructor will manage the writing task. However, in the weeks between the first and second sessions, almost all ELLs stopped attending classes, and so, had no instructor. Second, many of these tools expect learners to compose essays, making a desktop-based application appropriate. However, most of our ELLs were job hunting or had full-time jobs and personal commitments that made regularly writing essays unfeasible. During the second session, we realized our participants required a tool that would allow them to complete short, consistent writing exercises and get feedback for improvement without instructor involvement. Thus, we began envisioning a mobile app where networks of learners provided feedback to one another on quick, daily writing exercises in a self-sustained system. Through these interviews, we constructed an understanding of the complexities in our mature ELLs' learning environments, putting us in a stronger position to start designing technology that could be integrated into learners' real-world work flow, thus addressing imbalances in their access to learning opportunities.

2.4 Advantage four: Brings theory into the real world

The final phase consists of a PD session. We drew on PD guidelines (Birch & Epp, 2015), while ensuring design decisions were supported by educational research. Participants worked in groups of three to complete sketching activities around the design of a low-fidelity user interface prototype on paper, augmented with additional props such as sticky notes. We chose this process because PD can extend theoretical principles into practical findings which can be incorporated into the development of real-world, usable technologies, provided the PD is well-grounded in theory from the start.

One important design decision for learning analytics is the information type and granularity to include (Bull & Kay, 2007). Too little information may not support a well-informed decision-making process, while too much may distract. Applying this decision in real-life contexts is challenging as it is not always clear what "too little" or "too much" looks like. One objective of our PD session is to find this balance. For instance, one feature participants design is the analytics they will receive as they complete a writing task. We have created mock-ups of several possible prompts, each of which requires different levels of learner reflection. These prompts range from short writing tips (low), to a post-writing checklist (medium), to self-assessment (high). Our goals are to have these prompts springboard design ideas that support meaningful revision without overloading the learner.

3 CONCLUSION

Though CI and PD are rarely used in educational contexts, incorporating these methods can help researchers gain a more holistic understanding of learners and the learning context, as illustrated by our study. We found the psychometric scales, synthesized with CI methods, helped provide a comprehensive and holistic understanding of both the challenges and needs of ELLs learning to write. CI and PD complement existing practices, most importantly, they can guide researchers in drawing theory into practice. Preliminary analyses, including the designs generated from PD, challenges and suggestions for future directions will be discussed at the workshop.

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