

From Data to Actions: Unfolding Instructors' Sense making and Reflective Practice with Classroom Analytics

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ABSTRACT: The ultimate goal of using learning and teaching analytics dashboards is to improve teaching and learning processes. Instructors that use an analytics dashboard are presented with data about their students and/or about their teaching practices. Despite growing research in analytics dashboards, little is known about how instructors use the dashboards, make sense of the data they receive, and reflect on it accordingly. Moreover, there is limited evidence on how instructors who use these dashboards take further actions and improve their pedagogical practices. My dissertation work addresses these issues by actively involving the instructors in the design phases of the dashboard and examining their sense making, reflective practice and subsequent pedagogical actions they take based on their classroom analytics. My dissertation includes three phases: (a) systematic literature review that identifies problems & patterns from instructor use of dashboards (current), (b) implementation and examination of instructors' sense-making and reflective practice (current) and (c) human-centered approaches to co-designing instructors' dashboards with stakeholders (current). The findings will contribute to the conceptual basis of instructors' change of their pedagogical practices and practical implications of human-centered principles in designing effective dashboards.

Keywords: instructor dashboards, sensemaking, reflective practice, human-centered design.

1 INTRODUCTION

In the past decade, learning analytics dashboards have been identified as critical emerging technologies that have high expectations on unfolding the black box of teaching and learning complex processes (Johnson et al., 2016; Wise & Jung., 2019). Instructors using analytics dashboards are presented with visual graphs that include information about their students and/or their teaching strategies (Park & Jo, 2015; Verbert et al., 2014). Instructors' ability to transform the information from the data present on dashboards into actionable pedagogical practices is one of the highly touted potential outcomes of dashboard use; yet literature reveals that most instructors struggled in connecting the data with their teaching practices (Wise & Jung, 2019). Moreover, research is still scarce in examining how exactly instructors respond to and make use of analytics from dashboards (van Leeuwen et al., 2017), with the current literature highlighting great differences in how instructors used dashboards, how they made sense of the data, and what actions they took accordingly (if any) (Molenaar et al., 2019). Missing from learning analytics research is an investigation of how instructors interact with data and how they can use this data to change pedagogical practices.

Moreover, although a substantial literature has been dedicated to understanding effective analytics dashboards design (for e.g., Martinez Maldonado et al., 2016; Bodily & Verbert, 2017); yet the impact of using them in improving teaching and learning is still not evident (Viberg et al., 2018). The main challenge presented in the literature is rooted by disconnectedness of the users interacting with the dashboard while focusing more on the technical aspects of dashboard design. There is a

recent shift in the field towards human-centered learning analytics that assures that “meanings, interaction opportunities, functions and attributes associated with the system should be defined by the people for whom the system is intended, rather than imposed by designers and researchers” (Buckingham Shum et al., 2019; p2). Human centeredness is defined in different ways and at different levels, yet in all ways it encompasses designing systems with users rather than for users. Thus, there should be consensus on the processes of integrating a human-centered perspective while taking into account the aforementioned identified problems of instructors’ sense making and reflective practice to take subsequent actions accordingly.

2 CURRENT KNOWLEDGE & CONCEPTUAL FRAMEWORK

2.1 Instructors’ Use of Analytics & Perceived Challenges

Instructor dashboards are a specific application of learning analytics dashboards that allows instructors to monitor their students’ progress and evaluate their teaching strategies. The prominence of using analytics seeks to acquire insightful feedback from data that ordinarily would not be captured or recalled, except with the application (Ndukwe & Daniel, 2020). For instance, while some dashboards present instructors with visual graphs that include information about their students (Verbert et al., 2014) , others provide information about their facilitation of teaching strategies such as classroom management (Park & Jo, 2015). Using information about instructors’ and students’ actions can help instructors change their pedagogical practices (Gasevic et al., 2016).

Results from studies with instructors using the dashboards highlighted challenges in the adoption of the dashboard tools and in data literacy, two main themes that are interconnected at many levels. The adoption of such tools can be referred to as the intention to use technology tools and thus was explained through different models with the most common being technology acceptance model (TAM) that suggests the perceived usefulness and perceived ease of use of the tool influences the behavior of the user (Davis, 1989). Data literacy can be defined as the ability can be seen as a combination of being able to read and interpret information and possessing the skill to connect those inferences to relevant pedagogical knowledge to select an adequate follow-up action (Mandinach & Gummer, 2016). As such, data literacy is a complex construct that requires the measurement of several sub-constructs such as graph literacy, etc. (Van Den Bosch, Espin, Chung, & Saab, 2017).

The review on the research of the instructor dashboard revealed that most instructors struggled in connecting the data with their teaching practices (Wise & Jung, 2019). Moreover, there were great differences in how instructors used dashboards, how they interpreted information on the dashboard, and what kind of actions they took (if any) in connection to the data from the dashboard (Molenaar & Knoop-van Campen, 2019). Although the importance of data literacy is acknowledged, Schwendimann and colleagues (2017) indicate in their review of LADs that there is very little research that explores the relation between users’ data literacy and the usefulness of a dashboard.

2.2 Instructor Sense Making and Reflective Practice of Learning Analytics

An important aspect of using dashboards is to go beyond just the use of dashboards by examining what actions instructors take based on the data provided from the analytics. This can be conceptualized through instructors’ sensemaking and reflective practice that will dictate the subsequent actions to be taken. Sensemaking is a social process of searching for meaningful answers that drive the actions that individuals take (Weick, 1995). Sensemaking situated within analytics data requires instructors to understand what is happening, reflect on their practices and decide on what further steps to take to improve pedagogical strategies (Wise & Jung, 2019). Wise and Yung’s (2019) proposed a model of teachers’ process of analytics that embeds teacher activities within a two-part

structure of sense-making and pedagogical response. Reflective practice is a critical catalyst for improving pedagogical practices as it allows instructors to identify problems and plan for actions (Walkington et al., 2001). Reflection that occurs through data-informed feedback is significant since it allows making sense of the provided evidence (Avramides et al., 2015). As instructors look at the dashboard analytics, analyze data on it and make meaningful interpretations, the most prominent step is the actions that they take accordingly which can inform their future pedagogical practices. When compared with other traditional feedback from observational protocols, sensemaking can help better understand instructors' actions (Wise & Jung, 2019). Reflective practice can encourage instructors to use the automated feedback to foster teaching strategies.

3 TEACHACTIVE PROJECT

This project is based on an NSF IUSE grant titled "An Integrated Faculty Professional Development Model Using Classroom Sensing and Machine Learning to Promote Active Learning in Engineering Classrooms" (DUE #2021118). TEACHActive model uses machine learning and computational analysis of classroom analytics from an automated observation system, EduSense (Ahuja, 2019), and presents visual analytics via TEACHActive dashboard designed for engineering instructors (AlZoubi et al., 2021). Through the TEACHActive model, engineering instructors in higher education engage in a series of sense making and reflective practices. Raw classroom data is transformed into meaningful metrics, and then these metrics are being displayed as classroom analytics to provide practical feedback for instructors. TEACHActive model includes three main components (a) training on using pedagogical models (for e.g. active learning strategies), (b) automated classroom observation, and (c) feedback in the form of classroom analytics from automated observation followed by reflective prompts. Instructors use the automated feedback on the session display and the progress display to reflect on their pedagogical practices and take actions accordingly.

As such, instructors reflecting on their classroom teaching through the automated feedback can make pedagogical changes in their future sessions. For example, an instructor may devote additional time for group work if the data suggests that a substantial portion of in-class activities were dominated by the teacher.

4 RESEARCH GOALS AND QUESTIONS

The purpose of this research is to examine how instructors' active participation in this model inform change in their pedagogical strategies through sensemaking and reflective practices of analytics data. The research questions that guide my dissertation include the following:

RQ1. How do instructors make sense of classroom analytics displayed on dashboards?

RQ2. How can data from the analytics dashboard be linked/ aligned with instructors' reflection on pedagogical practices?

RQ3. What are effective human-centered design principles used to design dashboards with instructors?

RQ4. How do human-centered principles influence instructors' sense-making and reflective practices?

5 METHODS & CURRENT STATUS OF WORK

Following the designed based research methods and using human-centered design principles, we designed the first iteration and implementation of TEACHActive model and the corresponding feedback dashboard that visualized the automated classroom observation output (AlZoubi et al., 2021, a,b). Results from the pilot data of first implementation revealed that instructors identified some of the metrics to be more meaningful than others. For example, students' hand raises as a function of time (i.e. a scatter plot that lays the number of seconds of hand raises at different

moments of the class) was perceived to be more meaningful than numeric metrics that only provided a total frequency (i.e. total seconds of hand raises during class was 22 seconds). Instructors also perceived that the classroom analytics provided with reflective prompts on TEACHActive dashboard provided promises to facilitate feedback on their future teaching. Reflective prompts were particularly interesting to them as they assured instructors that the analytics on the dashboard is not evaluative but rather descriptive. A such, reflective prompts would provide a better context about what was happening during the class. An example would be showing instructors the total number of hand raises and asking questions about why were students raising their hands (whether it is to ask questions, participate in class discussions or another reason). Also, asking instructors whether they would like to set a goal for next session, and whether they find this metric descriptive and indicative of what was happening in their classrooms. Reflection prompts were added on a separate display and in relation to all the metrics provided on the session display.

5.1 Phases of my dissertation work

My dissertation work includes three main phases: a) systematic literature review that identifies problems & patterns from instructor use of dashboards (current), (b) implementation and examination of instructors' sense-making and reflective practice (current) and (c) human-centered approaches to co-designing instructors' dashboards with stakeholders (current). Figure 1 illustrates the three phases.

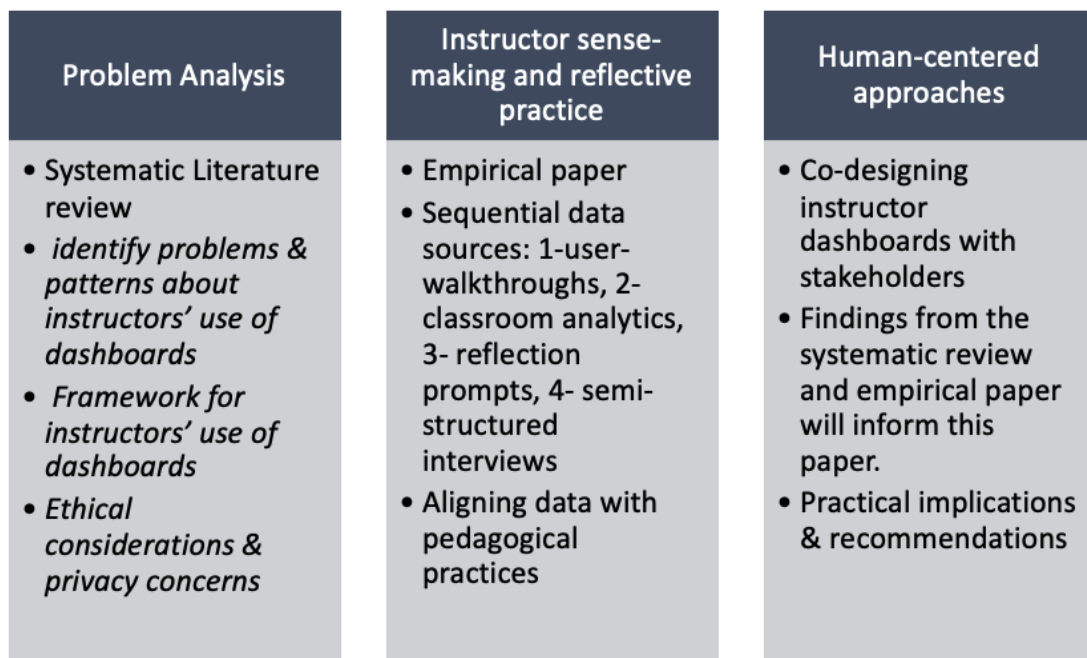


Figure 1. Three phases of dissertation

For the first phase, I am currently preparing a systematic literature review on the state of the art of instructor dashboards and their uses, empirical evidence from the literature on how instructors interacted with the dashboard, how they make sense of the data. Also, I am examining the affordances, the challenges and the practices used while providing instructors with analytics. I am using PRISMA guidelines and I aim to provide a framework for instructor use of dashboards as a contribution from this systematic literature review. This review is currently in the data analysis phase.

The second phase and the third phase of my dissertation will be simultaneously done with the future implementations of TEACHActive model. I aim to examine how instructors make sense and reflect on classroom analytics and what pedagogical actions do they take accordingly. For the second implementation phase of TEACHActive, instructors, first I will conduct user interviews and walk-throughs prior to TEACHActive automated observation implementation. In the user walkthroughs, I will walk instructors through the metrics present on the dashboard, examine which metrics they find meaningful, discuss their interpretations of each of the metrics, discuss expectations from the analytics data, understand their concerns and recommendations. Together with the instructors, we will co-design the reflection prompts displayed in a way that better targets their goals. After that, the automated observation will take place for four-weeks. During the four weeks, instructors will have two cameras in the class (one facing them and the other facing the students) that will track behavioral indicators from classroom through EduSense system (AlZoubi, 2021). EduSense tracks body positions of the instructor and the students in the room, hand raising, and their speech. Our particular features of interest include time spend sitting vs standing, hand raises, movement patterns, frequency of student speech, frequency of instructor speech, moments of silence, student vs. instructor speech (time and distribution over the class period) (Ahaju et al., 2019). After teaching each class session, instructors will be presented individually with the classroom data on the feedback dashboard. Instructors will receive an email notification that the classroom analytics are ready on the dashboard. They will be asked to review the classroom analytics and complete the short reflection prompts on the feedback dashboard. This automated feedback will illustrate the visual representation of behavioral indicators from the classroom in connection with the pedagogical strategies. For instance, changes in class activity (i.e., sit vs stand), student participation through hand raises, body positions, movement patterns, and the frequency and duration of instructor vs. student talk will be displayed on the feedback dashboard at the end of each session. Additionally, the feedback dashboard will present aggregated data of the captured features from instructor behaviors (e.g., sit vs stand, movement patterns, and body positions) and from student behaviors (e.g., hand raises, student vs. faculty speech, and frequency of speech). Comparison stats between sessions that reveals their progress (e.g., "There were 10 more hand raises in the second session compared to the first session," or "Your facilitation behavior increased by 22%") will be provided as well. The feedback dashboard will be used to promote instructors' reflective practice by gaining a better overview of the in-class activities, reflecting on their facilitation strategies, and addressing pedagogical changes in their next sessions. The reflection prompts will be personalized and based on each instructor's data. After the four-week observation period, I will conduct semi-structured interviews with instructors. Data from the interviews provides an in-depth understanding of their sense-making of the analytics data, how they use their pedagogical knowledge to interpret the feedback dashboard data and what actions they took in response to the displayed data. These interviews will also provide input to the future iterations and modification of the dashboard. I plan to measure instructors' sensemaking and reflective practice as well as any pedagogical change and action taken accordingly. I have pilot data for this phase that I am analyzing and modifying the phase accordingly. I need further revision and feedback on data sources and how to measure reflective practice and sensemaking. The third phase of my dissertation includes the human-centered co-design principles and recommendations for practical implications. For this phase, I will use the co-design with human-centered principles that I used with instructors. This part will be dependent on the systematic literature review findings and the empirical piece on how instructors make sense of the data and act accordingly. I already integrated human-centered principles in the first iteration, however, with more data, I will examine what principles were more effective as well as how these principles influenced instructors' sensemaking and reflective practice.

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