

Chapter 8

Data for Unobtrusive Observations of Learning: From Trace Data to Multimodal Data



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Abstract In this section, we collected articles that discuss the data needed to unobtrusively observe student learning. While a wide range of data can be utilized for this purpose, the proliferation of digital learning technologies provided many opportunities to collect data from students' interactions with digital learning tools and platforms. Typically referred to as trace or log data, it allows observing students as they learn in real-world learning contexts. As they are usually a byproduct of students' use of digital tools, they require little to no additional effort to be collected. The use of such data is an underlying fuel behind much of the research within the learning analytics field. It allows for quick collection and examination of learning data from a large number of students, providing insights into student learning that were not possible before through more traditional data collection procedures.

Keywords Trace data · Multimodal data · Unobtrusive observation

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V. Kovanovic et al. (eds.), *Unobtrusive Observations of Learning in Digital Environments*, Advances in Analytics for Learning and Teaching,
https://doi.org/10.1007/978-3-031-30992-2_8

1 Section Overview

While trace data is highly valuable in providing unobtrusive insights into student learning, there are significant limitations of such data, primarily due to a lack of context and rich descriptions of students as they engage in learning activities. To address these challenges, the use of multimodal data has witnessed significant interest from researchers. Such data typically involves several *channels*, each providing data and insights about different aspects of student learning. Some of those data include audio and video recordings of students in their learning environments, electrodermal activity recorders, and eye-tracking devices, to name a few. Combining these different channels makes it possible to paint a much richer picture of student learning than possible with simple trace data.

In this section, each chapter focuses on the effective use of multimodal data for understanding one particular aspect of student learning. Those include understanding student engagement, affect and emotions, self-regulation and co-regulation of learning, and student collaboration. As each of these aspects has been extensively covered in the existing research literature, the chapters outline how using different types of data sources moves the state-of-the-art in the unobtrusive measurement of learning. The questions in each chapter further our understanding of the interplay between different aspects of student learning. The following brief introductions provide a quick glimpse of how these authors view the unobtrusive observation of learning processes.

Chapter 9 Fatemeh Salehian Kia, Matthew L. Bernacki, Jeffery A. Greene. *Measuring and Validating Assumptions about Self-Regulated Learning with Multimodal Data*

In their chapter, Salehian Kia et al. provide detailed descriptions of how observational and self-reported data can be collected to provide more comprehensive descriptions of students' self-regulated learning. Using two empirical examples, the authors show strategies and approaches for aligning and mapping observational and self-reported data to provide richer insights into self-regulated learning than possible with only one data source.

Chapter 10 Megan Wiedbusch, Daryn Dever, Shan Li, Mary Jean Amon, Susanne Lajoie, Roger Azevedo. *Measuring Multidimensional Facets of SRL Engagement with Multimodal Data*

To provide valid and reliable insights into student learning, there is a strong need for theoretically grounding data collection, measurement and analysis, with the critical construct in this regard being student engagement. In their chapter, Wiedbusch et al. propose a new theoretical model that captures cognitive, emotional, and behavioral facets of engagement within self-regulated learning. The authors also review current approaches for conceptualizing and measuring student engagement and ways in which multimodal data can advance our understanding of student engagement.

Chapter 11 Philip H. Winne. *Roles For Information In Trace Data Used To Model Self-Regulated Learning*

The chapter of Winne discusses the importance of understanding the information associated with different learning trace data events and its use in understanding students' self-regulated learning. The chapter discusses how different operations and processes manipulate information and how effective understanding of students' cognition, metacognition and motivation requires taking into the account both trace data and the information processed by this trace data.

Chapter 12 Jonna Malmberg, Eetu Haataja, Tiina Törmänen, Hanna Järvenoja, Kateryna Zabolotna, Sanna Järvelä. *Multimodal Measures Characterizing Collaborative Groups' Interaction and Engagement in Learning*

The chapter by Malmberg et al. on how multimodal data can be unobtrusively used to evaluate and gain insights into students' collaborative learning and team collaboration, with a particular focus on cognitive and socio-emotional student interactions and co-regulation of learning and team synchrony. Using an example involving EDA wearables and video recordings of student collaboration, the authors showcase how different types of interaction unfold over time alongside team synchrony, which is measured by the similarity of physiological EDA measures of individual team members.

Chapter 13 Victor Lee. *Electrodermal Activity Wearables and Wearable Cameras as Unobtrusive Observation Devices in Makerspaces*

This chapter describes how data from wrist-wearable devices that capture skin conductance levels, also known as electrodermal activity (EDA), can be used to unobtrusively measure student learning and engagement. Mainly focusing on learning within the makerspace context, Lee provides an overview of the makerspace use in education, the history of electrodermal device use in learning science research and the theoretical construct of engagement, which over time moved from simple attendance to measures of electrodermal activity.

Overall, the data discussed in the chapter involve survey data, trace data, EDA wearable data, and audio and video recordings of student learning. Such data provides detailed and unobtrusive descriptions of student learning, allowing for bringing research closer to real-world learning environments. We hope that you find the following chapters useful and informative and help you further advance your own research involving the unobtrusive measurement of student learning.