A Review of the Evolving Definition of Orchestration: Implications for Research and Design

LuEttaMae Lawrence, University of Illinois Urbana–Champaign, llawrnc2@illinois.edu
Emma Mercier, University of Illinois Urbana–Champaign, mercier@illinois.edu

Abstract: The term *orchestration* describes how teachers manage learning in the classroom. However, interpretations of the term have influenced the application of the definition in research. In this paper, we discuss a review of orchestration technology and analyze the definitions of orchestration with respect to the research conducted and the design of orchestration tools to support teachers. We then discuss implications for the *design* of orchestration tools.

Introduction

The term *orchestration* has been used in various ways over the past few decades to describe how teachers manage learning in the classroom and how technology can support them in doing so (Dillenbourg, Prieto, & Olsen, 2018). However, there is considerable variability in how the term is defined and conveyed in research (Prieto, Dlab, Gutiérrez, Abdulwahed, & Balid, 2011). The term orchestration has been adopted by the Learning Sciences community, specifically Computer Supported Collaborative Learning (Dillenbourg, Jarvela, & Fischer, 2009) and emphasized as a "*grand research challenge*" (p. 3) in the field of Technology Enhanced Learning (Gillet, Scott, & Sutherland, 2009). Since this work, the definition of *orchestration* has become subject to criticism, and, the way it has been framed, we believe has influenced how researchers conduct studies in these areas.

Another area that has shaped the research in the field of the Learning Sciences was the call for interdisciplinary work with Human Computer Interaction (HCI) (Rick, Horn, & Martinez-Maldonado, 2013). While collaborations between the Learning Sciences and HCI have become more common, a significant gap in the Learning Sciences is the lack of interdisciplinary reliance on design experts. Design has become a term that is overused and often undefined in research. In this review of the orchestration literature we specifically analyze how design is discussed and portrayed in the literature.

The issues of conflicting definitions pose an important question: how have different definitions of orchestration influenced the research conducted on teacher supportive orchestration tools? We are especially interested in studying the influence of those conflicting definitions on how researchers approach and evaluate the design of orchestration tools. To address this question, we compiled empirical articles that describe orchestration tools for teachers, identified what citations the authors assumed to define orchestration, and analyzed the definition's implications on their research especially bearing in mind the design of the tool. This paper specifically addresses the design

Methods

We conducted a search on the ERIC database for articles with orchestration in the title ($N = 25$ articles) or abstract ($N = 99$ articles) from 2009 to 2018. Of the 124 found articles, 101 articles were excluded by analyzing the titles and abstracts for relevancy, i.e. they were either not a research study, not from an education context, involved online learning (e.g., MOOCs, social media topics), did not include some form of technology to support teachers, were dissertations or thesis papers, or were conducted before 2009. The remaining 23 articles were coded for their definition of orchestration based on the research they cited, the focus of their research questions, methods, participants, setting, and the authors' descriptions of the teachers' experience. Due to the scope of this poster paper, we only discuss analysis from the definition of orchestration and the focus of the research questions.

Results

Of the 23 articles coded, 17 articles referenced at least one of five different papers written by Dillenbourg and colleagues to define orchestration (Dillenbourg, 2013; Dillenbourg et al., 2011, 2009; Dillenbourg & Jermann, 2010; Fischer & Dillenbourg, 2006). Three articles referenced Trouche (2004), four articles referenced Prieto et al. (2011), and two articles referenced Roschelle, Dimitriadis, & Hoppe (2013). Eight remaining articles were only referenced once. Regarding research questions, across all articles, the majority of questions focused on the teachers (15 articles) and students (10 articles). Five articles asked questions related to the design of the technology and six articles asked questions regarding methods to assess orchestration tools.

Discussion

Of all the definitions identified in this body of literature, there is no trend in definition use across years, other than the majority use of Dillenbourg and colleagues' citations to describe orchestration. However, it seems there is some consensus in the use of Dillenbourg's definitions of orchestration as it is applied across all categories of research questions, methods, and study contexts. While all of the articles that used Dillenbourg to define orchestration are positioned around the same general definition, the sequence of these papers is something to grapple with when considering the implications on the researchers that cited them.

Of the 23 articles in this review, only five articles addressed questions about design. There are a vast number of questions that can be asked about the design of orchestration in terms of representation, inclusion, interaction, implementation, process, equity, and more. Questions within design need to be addressed to help the field build more impactful tools, learn about their uses in the classroom, and understand more about design assessment. Of these five articles, only one explicitly addressed issues of the process to design the orchestration tool. While we understand that authors can be implicitly study the design of orchestration tools we hope to see this more prominently discussed in future papers.

Implications

The process to build and assess the use of orchestration technology from a design perspective is something that needs more consideration in the orchestration research. A recent review indicated that outcomes of orchestration technology are typically user perceptions or learning outcomes (Bodily et al., 2018). User perceptions are a valuable step in the design *process*, but researchers claim usability evaluations are not enough to *assess* a design (Rick et al., 2013). This research and the present review indicate a need for more rigorous methods to evaluate the design of a tool in the context it is built for, as well as through the goals of the design and the desired learning parameters.

References

Bodily, R., Kay, J., Aleven, V., Jivet, I., Davis, D., Xhakaj, F., & Verbert, K. (2018). Open learner models and learning analytics dashboards. *Proceedings of the 8th International Conference on Learning Analytics and Knowledge - LAK '18*, 41–50. https://doi.org/10.1145/3170358.3170409

Dillenbourg, P. (2013). Design for classroom orchestration. *Computers and Education*, *69*, 485–492.

Dillenbourg, P., Jarvela, S., & Fischer, F. (2009). The evolution of tesearch on computer-supported collaborative learning. In N. Balacheff, T. de Jong, S. Barnes, S. Ludvigsen, & A. Lazonder (Eds.), *Technology-Enhanced Learning: Principles and Products* (pp. 26–42). Springer. https://doi.org/10.1007/978-1-4020-9827-7

Dillenbourg, P., & Jermann, P. (2010). Technology for classroom orchestration. *New Science of Learning: Cognition, Computers and Collaboration in Education*, (February), 525–552. https://doi.org/10.1007/978-1-4419-5716-0

Dillenbourg, P., Prieto, L. P., & Olsen, J. K. (2018). Classroom orchestration. In *International Handbook of the Learning Sciences* (pp. 180–190).

Dillenbourg, P., Zufferey, G., Alavi, H., Jermann, P., Do-lenh, S., & Bonnard, Q. (2011). Classroom orchestration: The third circle of usability - Why is paper highly usable in classrooms? *CSCL 2011 Proceeding*, *I*(January), 510–517.

Gillet, D., Scott, P., & Sutherland, R. (2009). STELLAR European Research Network of Excellence in Technology Enhanced Learning. In *Intl Conference on Engineering Education & Research* (pp. 1–8).

Prieto, L. P., Dlab, M. H., Gutiérrez, I., Abdulwahed, M., & Balid, W. (2011). Orchestrating technology enhanced learning: A literature review and a conceptual framework. *International Journal of Technology Enhanced Learning*, *3*(6).

Rick, J., Horn, M., & Martinez-Maldonado, R. (2013). Human-computer interaction and the learning sciences. In *International Society of the Learning Sciences* (Vol. 2, pp. 451–455).

Roschelle, J., Dimitriadis, Y., & Hoppe, U. (2013). Classroom orchestration: Synthesis. *Computers and Education*, *69*, 523–526. https://doi.org/10.1016/j.compedu.2013.04.010

Trouche, L. (2004). The complex process of converting tools into mathematical instruments: The case of calculators. *International Journal of Computers for Mathematical Learning*, *9*, 281–307.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. 1628976. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.