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Heterochrony through moment-to-moment interaction: A micro-analytical exploration of learning as sense making with multiple resources

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ABSTRACT

This article contributes to a deeper understanding of learning with multiple resources, widely available due to digitalisation. We claim that concepts such as participation trajectories, emergence and heterochrony enable an analytical account of learning as sense making, involving its temporality. We explore two cases: history learning in a secondary school and web development in a computer engineering course. The findings show that participants struggle to make sense of the multiple resources and their combined meanings, but overcome obstacles by taking initiative and solving problems together. Central implications are that learning with multiple resources places high demands on the learners' participation, and the need to account for the moment-by-moment actions in a long-term, shared process, spread across participants, materials and contexts.

1. Introduction

Activities spanning multiple contexts and access to widely available information and knowledge resources are becoming common features of learning, both in formal educational settings and elsewhere (Beauchamp & Kennewell, 2010; Chou, Block, & Jesness, 2012; Dolonen & Ludvigsen, 2012). Although it is generally considered beneficial for learning, access to widely available knowledge, resources and tools distributed across various contexts also presents challenges. There is increased acknowledgement that contemporary learning is less about accessing information and performing pre-scripted activities and more about making sense of knowledge from a multitude of sources, and employing this knowledge to solve problems or execute complex tasks. Such complex tasks often involve reaching beyond the boundaries of the pre-defined instructional process and traditional knowledge sources and engaging in more open-ended, less structured sense-making processes (Säljö, 2010). From a learner's perspective, the challenges associated with this distributed sense-making process lie primarily in how to gather and understand knowledge, and capitalise on the availability of larger pools of (expert) knowledge at their disposal. The nature of this sense-making process still needs to be articulated and investigated empirically.

In the context of these evolving dynamics, learning sciences research is increasingly concerned with the challenges surrounding the examination of learning that spans multiple contexts due to (digital) technology (Goodyear, Jones, & Thompson, 2014; Kumpulainen & Mutanen, 2000). Sociocultural studies of sense making especially (Engle & Conant, 2002; Krange, 2007; Ludvigsen, Rasmussen, Krange, Moen, & Middleton, 2010; Twiner, Littleton, Coffin, & Whitelock, 2014) have addressed aspects of learning that involve the use of multiple digital knowledge resources. Some other studies have focused

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on how meaning and knowledge are generated through individual or collective actions and have employed the notion of trajectory of participation to account for how the learning process unfolds over time (Damşa, 2014; Mercer, 2008; Rasmussen, 2012). Several of these studies show that there are various historical, sociocultural and material aspects that are essential to the sense-making process, but the way these aspects enable or create obstacles for learning and sense making still needs further examining. There is a need for better understanding of how aspects of the sense-making process (e.g., participants' actions, knowledge (re)sources and characteristics of the [material and digital] context) blend together and generate learning experiences, as well as how these processes rely both on planned and emergent activities.

In this contribution, we initiate an exploration of learning conceived as a sense-making process that emerges according to the way knowledge resources are used in learning activities. The aim is to generate a better understanding of emerging contemporary sense-making practices in the wake of the increased impact of digital technologies, which make it possible for learners to access resources at multiple sites (offline at the school site, online, etc.). Such an exploration involves accounting for the temporality of the process, i.e., how actions taking place in a micro-level setting (e.g., of a task or project) contribute to a broader timescale within which sense making occurs. It also concerns how the available knowledge resources feed into the sense-making process and how this sense-making process can contribute to the pool of evolving knowledge. To address these aspects, our examination is guided by the following research questions:

1. How can we analytically account for sense-making processes with multiple resources?
2. How do resources situated at various sites enable the sense-making process?
3. How does sense making conceived as participation in moment-by-moment actions adhere to a larger timescale?

We examined interaction sequences originating in learning activities from two different domains and educational settings: secondary school history and computer engineering education. We have selected these two cases because of their distinct differences in knowledge, learning practices and resources. The two cases provide a complementary perspective, which allows us to explore how cross-domain features of the participants' engagement emerge and how the knowledge available at various sites is assembled to enable the sense-making process.

2. Studies of learning as sense making and participation trajectory

Learning as sense (or meaning) making is a process that builds on combinations of individual contributions, collective processing and mediational resources (Wertsch, 1985) and in which meaning emerges, is stabilized and generates potential for new meaning making. Accordingly, it is in social interaction that individuals align existing or new ideas, knowledge and experiences to create new meaning and use resources.

The notion of trajectory of participation has been used to investigate how sense-making processes unfold over time, identifying the importance of the situated interactional accomplishments needed to capitalise on multiple resources (Damşa, 2014; Krange, 2007; Ludvigsen et al., 2010; Twiner, Littleton, Coffin, & Whitelock, 2014). Several have focused on learning *tasks* as central to the processes that unfold, and a seminal set of studies has analysed these processes in terms of *framing* (e.g., Engle & Conant, 2002; Furberg & Ludvigsen, 2008). Learning tasks resemble complex knowledge practices and are designed to trigger engagement with domain-specific knowledge or with peers. Tasks are jointly (and often continuously) reconstructed by learners as they seek to translate generated meaning or knowledge into a response in the form of a material and semiotic representation (e.g., a presentation, an essay, an equation or a table). Understanding how to go about a school task depends on learners' contextualisation attempts. Studies exploring students' understanding of given tasks in different situations—a highly structured and an open-ended learning environment—have found that interpreting the task was the main activity in both cases (Rasmussen, Krange, & Ludvigsen, 2005) and that the task was treated in practice as being open to additions and modifications (Dolonen & Ludvigsen, 2012). Essential analytical tools used to explore such processes include *dialogical meaning making* or *productive interactions*; this set of studies placed emphasis on the analysis of learners' verbal interactions and construction of meaning/knowledge through discourse and increasing understanding of concepts (Damşa, Ludvigsen, & Andriessen, 2013; Ludvigsen et al., 2010). Empirically, these studies have employed what is called sociocultural discourse analysis and/or interaction analysis to examine verbal interactions, as well as the historical and dynamic aspects of dialogue (Jordan & Henderson, 1995; Mercer, 2004). A central outcome has been talk types (e.g., disputational, cumulative and exploratory) to analyze the interactive and communicative process of reasoning through talk. Furthermore, notions such as *dialogical space* or *ground rules*,*positioning* and *agency* are employed to capture the way both meaning and identity are negotiated through talk (Damşa, Kirschner, Andriessen, Erkens, & Sins, 2010; Mercer, 2008; Engle & Conant, 2002; Kumpulainen & Lipponen, 2010; Rajala, Kumpulainen, Rainio, & Lipponen, 2016). These notions enabled the unveiling of the characteristics of talk, as well as the connection of talk to the historical-contextual features of interaction. Engle and Conant's (2002) work on disciplinary engagement with biological concepts "combines moment-by-moment, interactional aspects of student engagement with ideas of what constitutes productive discourse in a content domain" (p. 400), showing how the students took on stances in relation to a controversy about classification problems. The analysis demonstrates that focusing on interactional achievements can show how institutional elements (in this case a set of guiding principles that the teacher followed) influence the participants' activities.

The notion of participation *trajectory* is employed in studies that attempt to explain the co-construction process at a micro-level and to expand this view to a dynamic one that captures progress within the given time boundaries (Rasmussen, 2012).

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