ELSEVIER

Learning through interaction and the co-construction of knowledge objects in teacher education

Crina I. Damşa *, Sten Ludvigsen

Department of Education, Faculty of Educational Sciences, University of Oslo, Postboks 1092, Blindern, 0317 Oslo, Norway

ARTICLE INFO

1. Introduction

Learning in current higher education is no longer about accessing information or relying on teaching by others, but about making meaning of and employing knowledge in different tasks, activities or settings, and about jointly generating knowledge. Various studies (e.g., Aditomo et al., 2013; Damşa & Nerland, 2016; Muukkonen et al., 2010) emphasize that learning activities should offer students the opportunity to learn to address open and complex problems, collaborate and interact to generate new meaning and knowledge, and engage in knowledge work that involves sophisticated solutions and knowledge objects. Empirical research on collaborative learning varies from topics of interactional meaning-making (e.g., Atwood, Turnbull, & Carpendale, 2010; Havnes, Christiansen, Bjørk, & Hessevaagbakke, 2016; Dahlberg & Bagga-Gupta, 2013) to the relational or procedural aspects of collaboration (e.g., Baker, Andriessen, & Jaarvela, 2013; Barron, 2003; Stokoe, Benwell, & Attenborough, 2013). Few, however, have attempted to elucidate the empirical conditions under which the products of interaction – knowledge objects in this particular case – emerge from the collaborative process and how these objects impact further activity and interaction. Further, few studies have delved into empirical examinations of how generating knowledge in the context of interaction takes place, how this knowledge is shaped and materialized into knowledge objects and how these knowledge objects co-evolve as part of a learning process. We argue that the research problem in focus can be articulated through the following research questions: (1) In what way are knowledge objects co-constructed through small group interaction? (2) How is knowledge co-elaborated into knowledge objects, and how do knowledge objects evolve over time? and (3) Which aspects of the knowledge object co-construction are important for learning?

Theoretically, we take a stance that depicts learning as involving *interaction* between participants, and we elaborate on the concept of the *knowledge object* as a central notion of the interactional process that leads to joint knowledge construction. We approach these processes based on the premise that knowledge objects are *evolving* entities that shape and are shaped by the interactions around them (Stetsenko, 2005). Empirically, we examine how participants conceive of an open-ended problem, which knowledge is activated, how this knowledge is materialized into knowledge objects and how these objects are developed over a longer period of time. We analyse empirical data from three student groups involved in collaborative projects that required inquiries into new topics and collaborative work to create shared knowledge objects. We use qualitative methods and contrasting groups for a comparative approach, and we develop an analytic stance that permits the examination of the interactions and of the co-evolving knowledge objects.

* Corresponding author at: University of Oslo, Postboks 1092, Blindern, 0317 Oslo, Norway.
 E-mail addresses: crina.damsa@iped.uio.no (C.I. Damşa), s.r.ludvigsen@iped.uio.no (S. Ludvigsen).

We begin with a review of the notion of knowledge object. We then clarify the theoretical background of the study and frame our conceptual and analytic approach. We present the research design, settings and the empirical analysis of three contrasting groups. The discussion focuses on the interconnection between the different aspects of interaction and knowledge object construction and in relation to learning, as well as the implications of the findings and ideas for further research.

2. The knowledge object in literature

There are no indisputable definitions of the concept of knowledge object. Various theoretical perspectives are used to conceptualize the term and the purposes and functions this concept fulfils in various domains and types of activity. Stetsenko (2005) problematizes the idea of human activity as object-related and emphasizes that objects (or tools) are part of a three-fold dialectical system: material production, social exchanges among people and the individual mechanisms regulating these processes. This perspective highlights the interdependence of the three aspects; objects and tools are not only part of the cultural–historical heritage that provide the opportunity for material practice and social exchange but also of the expression of individual subjectivity in relation to the others. This view expands the principle of object-relatedness and emphasizes the idea that human development can be driven by objects, as a generic expression of the material and social world; accordingly, human beings can also *perform upon* and *transform* the world by creating and reconstructing objects.

Sociology of knowledge perspectives focus on *epistemic objects*, depicted as being the same as research objects or epistemic things (Knorr-Cetina, 2001). These can be material entities or processes as well as outcomes of knowledge work. This perspective emphasizes the difference between a) objects as instruments, or *technological objects*, which are ready-to-use, means-to-an-end; and b) *knowledge objects*, which are question-generating and open to exploration or transformation. The latter is represented by the open, changing character of an object and is more of a process and projection rather than a definitive entity. Such objects are characterized by their incompleteness and their evolving character (Ewenstein & Whyte, 2009). Miettinen and Virkkunen (2005) refer to knowledge objects as open-ended projections oriented toward something that does not yet exist or toward something that is not yet known and, consequently, generates new conceptions and solutions. Traditionally, there is a distinction between knowledge objects and *knowledge artifacts*, with the former referring to the object of inquiry and the latter to the tools that mediate the achievement of these objectives. Bereiter (2002) and Paavola and Hakkarainen (2005) elaborate on the notion of conceptual artifacts, which can be ideas, concepts or theories—entities that facilitate knowledge generation.

With these specifications as a backdrop, we will use a distinction between the *generalized* and the *situational object* (Jahreie, 2010; Engeström & Sannino, 2010). Generalized objects of activity are historically developed and answer societal needs (e.g., assessment systems at national level), while situational objects are manifestations of historical objects but are procedurally and discursively constructed (e.g., an assessment procedure in an institution). These are constructed by participants during the flow of action. The interaction among participants, in this case, is only understandable in relation to this situated knowledge object they construct together. The relationship between the knowledge object as an object of inquiry in continuous development and the inquiry process becomes more visible when we differentiate situational objects that are being created and artifacts involved as resources or tools.

2.1. The knowledge object in empirical studies

Studies of learning through knowledge building activities attempted to describe the role of knowledge objects in these types of processes. In a study of *digital portfolios* scaffolding collaborative inquiry, the portfolios are learning products and served to assess the collective aspects of learning, but also reflected students' individual progress and contribution to community knowledge (Van Aalst & Chan, 2007). Lee, Chan, and van Aalst (2006) noted the formative value of the portfolios, which contain the students' developing ideas and support their in recognizing and sense-making of productive discourse. Focusing on knowledge advancement at an individual level, these studies do not address whether and how interaction contributes to building notes, discussion threads or portfolios. Studies on collaborative learning in medical education (Hmelo-Silver, 2003) depicted (*visual*) *representations* as knowledge objects involved in collaborative problem solving, by analysing how technology mediates the interaction and how student-generated representations (of ideas, phenomena) mediate, but also trigger and sustain the collaborative construction of knowledge. The findings showed that the use of visual representation produced by the students' themselves enhanced their understanding of the problem and engaging in collaborative sense making.

A number of studies of collaborative learning in higher education identified aspects related to the development of knowledge objects as both *objects of inquiry* and as *scaffolds* for the inquiry process. Muukkonen, Lakkala, and Hakkarainen (2005) started with the assumption that the progressive inquiry process benefits from a shared representation, which can be a visual or textual artifact (in this case, learning logs) and showed that technological scaffolding supported the creation of the problem setting, meta-reflection, and highlighted aspects of how to build on others' ideas and monitor collective idea advancement. Muukkonen and Lakkala (2009) examined the development of the meta-skills of undergraduate students in the context of collaborative inquiry involving knowledge objects, heavily emphasizing process aspects. With regard to the knowledge object, the groups devised common plans, which they used as guidance for their inquiry questions. Groups that focused more on the object-oriented aspects of inquiry elaborated their knowledge objects more explicitly and appeared to be more self-critical about the process. Finally, Damşa and Nerland (2016) analysed ways of interacting and generating knowledge during collaborative inquiry of teacher and engineering students and found that knowledge objects (e.g., analysis reports, drawings, developing software) support students in making knowledge explicit and actionable.