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Learning to Learn in STEM Subjects: Lessons Learned from Problem-Based Learning in Medical Education

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Background

For non-mature students, the transition to university marks a key shift in a ways of learning (Harvey, Drew, & Smith, 2002). As Gamache (2002) argues, making the characteristics of this new way of learning explicit would enable students' successful transition to university. One approach to developing students' explicit attention to their learning is referred to as 'learning to learn' (Rawson, 2000). Learning to learn is discussed with promising potential (European Council, 2006), but implemented approaches have been criticised for their generic, skills-based emphasis (Gamache, 2002; Rawson, 2000; Wingate, 2007). As a response to these critiques, we explore the possibilities of Problem Based Learning (PBL). PBL offers a pedagogic strategy and structure for supporting students in self-directed learning that is integrated with the learning of core content knowledge and skills (Gallagher, 1997). However, relatively few examples (and related research) of PBL outside of medicine and gifted education contexts are available (Hmelo-Silver, 2004).

Research Questions

This paper draws on interview data with British medicine students in a PBL course and considers the implications of PBL for developing a 'learning to learn' approach that is sensitive to mathematically demanding subject areas. The research questions are:

(RQ1) What ways of 'learning to learn' can be identified from students experiences of PBL (based on student accounts of earning in interview data)?

(RQ2) How can learning to learn be theorised from a sociocultural perspective given these students' accounts of PBL? How was their learning mediated (e.g. by identity, tools and objects)?

(RQ3) Where are potential places of overlap and places of conflict between learner approaches reported by students across the case studies of university transition?

With RQ3, we consider ways our account of learning to learn applies to other courses which are mathematically demanding and in which a range of pedagogic strategies are used. Our aim is to develop a theoretical account of learning to learn that is based on the experience of a medicine PBL course, but is contextually sensitive to mathematically-demanding subjects such as mathematics, engineering and physics.

Methods

The analysis draws on data from a study of students' transitions into mathematically-demanding courses in Higher Education carried out as part of the UK-ESRC funded 'Transmaths' project (we gratefully acknowledge the support of the ESRC grant (RES-000-22-2890) for "Mathematics learning, identity and educational practice: the transition into higher education"). Seven case studies of science, technology, engineering and mathematics (STEM) courses, including Medicine, provide data on the learning contexts. The primary data used are a series of 3 interviews conducted with 50 students before and during their transition to university (the final interview conducted during first term of their second year) at 5 different institutions of Higher Education in England. The interviews were semi-structured to prompt students to share with us their biographies as learners and to reflect on their experiences during their first year at university.

Interviews were transcribed and analysed thematically with regards to learner approach, facilitated by the use of Nvivo qualitative data software. Segments of interviews in which students reported on pedagogic practices were coded and examined as key data informing our understanding of the ways these students experienced pedagogic practices, such as PBL and lectures. Finally, these coded interviews were analysed using sensitising concepts of identity and cultural models as described in the analytic framework below.

Frame

From a socio-cultural cultural-historical (CHAT) perspective, learning to learn cannot be understood separately from an understanding of the learning context (e.g., the university or classroom or course field of study). This assumption provides the basis for the analysis which is grounded in case study and interview data. The approach to analysis of interviews is based on a view of language-in-use as socially situated. The underlying argument is that discourse is dialogic (Bakhtin, 1981) and reflexive (Gee, 1999), playing an active role in the development, organization and interpretation of socially-situated interactions and activity systems (Engeström, 2001). The analyst's interpretations of discourse-in-use are based on the surrounding text or discourse, as well as knowledge regarding language use (Gee, 1999).

The analysis of learning to learn is framed by activity theory, drawing in particular on the notions of mediation and reflection. In reflection (on learning), the individual distinguishes the subject and the object in activity and in doing so, 'purposefully attempt to reconsider and transform the content of his/her activity' (Dimova & Loughran, 2009: 212). Through reflection, the student gains knowledge of the self and of the characteristics of the activity itself (e.g. university learning). 'Cultural models' (Gee, 1999) and leading identity (Black et al., 2010) are mediating influences explored through the analysis. Leading identity is a concept which builds on Leont'ev's (1981) notion of leading activity regarding particular activities (and their related objects) which are the driving force for psychic development. In this analysis, we contrast learning in relation to different leading activities (e.g. learning to learn and learning to become a doctor) in the context of university education to theorise learning to learn.

Research findings

The analysis of PBL which draws on CHAT to theories allows us to explain 'learning to learn' as an action within the activity, where the object is 'achieving at university degree level'. Ideally, learning to learn is an action which takes place in tandem with the action of learning mathematics, medicine or physics. The analysis draws our attention to mediating factors that can be addressed in pedagogic practice and in higher education policy (and potentially inform the ways we prepare students for higher education learning). Specifically, we explore ways that cultural models and identities (informed in part by leading activity) mediate learning to learn. The nuanced perspectives of PBL offered by students in our case study elaborate on potential resources (including conceptual resources) which may support students in learning to learn in mathematically demanding subjects.

References will be provided in the full paper