USING PEER TUTORING TO OPTIMISE KNOWLEDGE SHARING IN LEARNING NETWORKS: A COGNITIVE LOAD PERSPECTIVE

Ya Ping Hsiao, Francis Brouns, Liesbeth Kester and Peter Sloep

CELSTEC, Open University of the Netherlands

ABSTRACT

Self-directed lifelong learners often intentionally look for non-formal learning opportunities. Learning Networks (LNs) provide them with an online social network to share knowledge with others. Lacking a formal social structure, the educational environment of non-formal LNs is different from formal learning settings. Thus, knowledge sharing becomes difficult because the learning environment of LNs could induce cognitive load, especially when learners deal with complex learning actions. A possible solution is to provide a structure to support interaction and thus reduce cognitive load. We propose peer tutoring as a support structure to assist learners to share knowledge.

KEYWORDS

Learning Networks, non-formal learning, cognitive load, knowledge sharing, complex learning, peer tutoring

1. INTRODUCTION

To live and work in this rapidly changing world, adults often look for non-formal lifelong learning opportunities to improve their knowledge, skills and competence after formal school education. Lifelong learners are self-directed: they look for an individualized learning environment that allows them to control their own learning activities based on their own learning objectives. Learning Networks (LNs) have been introduced as a suitable learning environment to cater for this self-directness (Kester et al., 2006; Sloep, 2009; Sloep et al., 2007). LNs are defined as “a particular kind of online, social network that is designed to support non-formal learning in a particular domain” (Sloep, 2009, p.64). The network is composed of a group of people who use learning resources to learn together at the time, place, and pace that suits them best in ways appropriate to the task (Harasim, Hiltz, Teles, & Turoff, 1995). Within LNs, learners are expected to take up responsibility not only to organize their own learning activities but also to share knowledge with their peers. However, little research has been conducted into how this may be achieved best.

In formal learning settings, knowledge is mostly transmitted by the teacher through pre-designed learning activities in which students sometimes learn from each other. LNs provide non-formal lifelong learners with a new educational environment where the prime responsibility for engaging learning activities and sharing knowledge is shifted from teachers to learners. Whether learning is effective depends on how apt learners are self-directing their learning and knowledge sharing. The new role of learners is to become knowledge sharers and the major question of interest is: how to share knowledge in LNs?

Knowledge sharing is a particular communication and collaboration process among/between two parties to attain mutual understanding of shared knowledge or to engage in coordinated efforts to solve the problem together. Whether learners collaborate effectively and efficiently determines the success of knowledge sharing. Since LNs are online social networks where learners do not come in cohorts or classes, there is no formal social structure in LNs. How do learners share knowledge with others? What method should we
develop to increase the likelihood that the expected interactions, collaboration, for knowledge sharing will occur?

To answer these questions, we want to use cognitive load as a common currency to investigate to what extent the lack of a formal social structure in LNs imposes cognitive load during the collaborative knowledge sharing process. Cognitive load theory (CLT) assumes that learning works best under instructional conditions that are aligned with the human cognitive architecture (Paas, Renkl, & Sweller, 2003; Sweller, Van Merriënboer, & Paas, 1998). The human cognitive architecture consists of a limited working memory (WM) and unlimited long-term memory (Paas, Renkl et al., 2003). When designing instruction and structuring information, using WM efficiently is thus the major consideration. CLT distinguishes three types of cognitive load. The load is called intrinsic if it is imposed by the number of information elements in a learning task and their interactivity. If it is imposed by the manner in which the information is presented to learners and by the learning activities required of learners, such as actively participating in LNs, it is called either extraneous or germane load. Intrinsic, extraneous, and germane load are additive. So, if learning is to occur the total load should not exceed available WM resources (Paas, Tuovinen, Tabbers, & Van Gerven, 2003).

2. KNOWLEDGE SHARING IN LEARNING NETWORKS

2.1 The educational environment of LNs

LNs are designed to support non-formal lifelong learning and learners are expected to share knowledge with others to achieve their learning objectives. Whether learners can collaborate effectively to share knowledge is thus the key to the success of non-formal learning in LNs. To achieve effective online collaborative learning, Dillenbourg and Schneider (1995) proposed that three conditions must be considered: group composition, communication media and task features. Based on these conditions, we first describe why it is more difficult for learners to collaborate with others in the educational environment of LNs than formal learning settings that adhere to CLT.

With regard to group composition, the participants in LNs are heterogeneous: they are likely to have different learning goals, academic backgrounds, competency levels and experiences, as well as knowledge about the learning topics. This heterogeneity can assure lively knowledge sharing in a community (Kester & Sloep, 2009). However, lacking a formal social structure would hinder learners in finding a relevant collaborator because they do not know who the collaborators should be, what others know and what others are doing now. Concerning communication media, LNs are online social networks where learners rely mostly on online communication to interact with others, which is quite different than face-to-face communication. The cognitive benefits claimed by collaborative learning must be mediated by the verbal exchanges among learners (Dillenbourg & Schneider, 1995). However, online communication that is mostly text-based and lacks non-verbal clues would hinder the collaboration process of knowledge sharing (Dillenbourg & Schneider, 1995).

From a CLT perspective, heterogeneous group composition forces learners to allocate extra cognitive resources to find a relevant collaborator for knowledge sharing, which is not directly related to learning itself and results in extraneous load. Compared to face-to-face contacts in formal learning settings, online communication for sharing knowledge in LNs also could yield extraneous load because verbalizing in written texts or using other media to exchange knowledge without non-verbal clues are not relevant for learning, either. To sum up, in LNs learners have to allocate cognitive capacity to structure collaboration and maintain the interactions of knowledge sharing, thereby diminishing the capacity available for learning and knowledge sharing itself.

Regarding task features, we concentrate on task complexity in this article. In LNs, there are no learning tasks mandated by fixed curricula. Instead, learners participate in LNs to conduct some actions to achieve their own learning objectives such as solving problems from their real life, learning materials provided and attending learning activities provided by LNs. To distinguish these “actions” in LNs from “tasks” in formal learning settings, we call them “learning actions”, which are defined as “any type of resources or events that help learners to acquire a competence” (Berlanga, 2007). These learning actions also vary in complexity. In the next section, we will further discuss the interaction between complexity of learning actions and the learning environment of LNs from a CLT perspective.
2.2 Complexity of learning actions and cognitive load

According to CLT, task complexity depends on element interactivity (Sweller, 2006). A task is complex if many elements interact and they cannot be understood in isolation; a task is simple if few elements interact or elements can be understood and learned independently of each other. Levels of element interactivity determine levels of intrinsic load. In addition, human WM can only simultaneously process a limited number of interacting information elements (Paas, Renkl et al., 2003; Sweller, 2006).

When a learner works on simple learning actions, his WM only has to process non-interacting elements or a few interacting elements at the same time. Based on the low intrinsic load, he can accomplish simple learning actions by himself within his WM capacity. Sometimes, a learner has to collaborate with others to share knowledge when he cannot find answers by himself. As has been discussed, the learning environment of LNs imposes extraneous load during the collaboration process and this costs a learner extra WM capacity to collaborate with others. Still, the total cognitive load remains within the limit of WM capacity because of the low intrinsic load of simple learning actions.

When a learner works on complex learning actions, his limited WM has to process many interacting elements at the same time because of the high intrinsic load. To have more cognitive resources, it is likely that learners turn to collaborate with others to share knowledge. Based on CLT, there are two cognitive benefits of collaboration. First, a joint WM can be assembled from individuals’ limited WMs. A group can be considered as an information processing system consisting of multiple individual WMs and then the joint WM has more processing capacity to deal with complex learning actions than the individual WM (Banich, 1998; Kirschner, Paas, & Kirschner, 2008, 2009). Second, it is assumed that the intrinsic load can be shared among group members and WM capacity can therefore be freed up by individuals to work on complex learning actions (Kirschner et al., 2008, 2009). However, the joint WMs and shared cognitive load can only work well when group members know how to collaborate with others.

3. PEER TUTORING AS A STRUCTURE TO OPTIMISE THE KNOWLEDGE SHARING PROCESS

We propose peer tutoring (PT) as a support structure to optimise knowledge sharing. PT is defined as “people from similar social groupings who are not professional teachers, helping each other to learn, and learning themselves by teaching” (Topping, 1996, p.322). The structures of PT include specific tutor-tutee roles, tutorial arrangements and tutorial procedures to promote success in tutoring (King, 1997, 1998).

3.3.1 Using PT to share knowledge on complex learning actions

The specific interaction structures of PT such as supportive communication, explanation and elaboration, asking questions and sequencing questions ensure that tutors and tutees are extra cognitive resources for each other (King, 1997, 1998): they profit from the processing effort of others, they help each other to remember or recall certain aspects of their interaction history and learning actions, and they prompt each other for additional information (King, 1998). In addition, PT is a structure using division of labour for reducing cognitive load. Through labour division, tutor or tutee takes responsibilities on some aspects of the task and this division lowers down the intrinsic load of the task for each of them (Dillenbourg & Betrancourt, 2006; Dillenbourg & Schneider, 1995).

3.3.2 Using peer tutor selection to find a suitable knowledge sharer

PT structure can include an automatic system to make optimal use of learners’ knowledge and find a suitable peer tutor based on the question content and other criteria, namely, tutor competency, content competency, availability, and eligibility (Van Rosmalen et al., 2008). This system decreases the extraneous load caused by finding a knowledge sharer in LNs.

3.3.3 Using PT training to scaffold knowledge sharing

Providing learners with a PT structure cannot guarantee that learners know how to behave as tutor and tutee. PT is an instructional approach typically equipped with training learners how to acquire these four skills:
pedagogical skills, social skills, managerial and organizational skills, and technical skills. Research on peer tutoring believes that training peer tutors in advance can help them go through the peer tutoring process effectively (De Smet, Van Keera, & Valcke, 2008; King, 1997).

4. CONCLUSION

This article identified that the complexity of learning actions may interact with the collaboration process during knowledge sharing in LNs where there is no formal social structure. Complex learning actions impose higher intrinsic load and the lack of a formal social structure imposes extraneous load. Therefore, the total cognitive load of dealing with complex learning actions may easily exceed an individual’s WM capacity and thus result in ineffective learning. We propose PT as a structure to optimize the knowledge sharing process from a CLT perspective. Within the PT structure, we discussed why tutor and tutee can profit from the extra cognitive resources of their partner and how the high intrinsic load of complex tasks can be shared by learners when they take different role tasks of being tutor and tutee. With peer tutor selection, we hypothesized, extraneous load can be decreased because learners do not have to allocate extra cognitive resources on finding a suitable knowledge sharer. To ensure that the PT structure works well, we suggested PT training to help learners be familiar with the collaboration structure and tutoring skills. In the future, we will carry out experiments to test the hypotheses that PT support structure can indeed reduce extraneous load and help learners share the intrinsic load of learning actions. PT training will be one the additional variables to be investigated.

REFERENCES


