TACIT KNOWLEDGE IN VIRTUAL UNIVERSITY LEARNING ENVIRONMENTS

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ABSTRACT

Knowledge work has become a major component of value creation, especially in industrialized countries. Processing knowledge in virtual ways becomes increasingly possible with emerging technological innovations. This leads to the important question, how to transmit elusive tacit knowledge in a virtual setting. Education at universities benefits from the use of virtual environments for passing on knowledge, such as by setting up MOOCs and using learning apps. How to manage tacit knowledge in virtual learning environments as well as how to prepare students for virtual organizational knowledge processes become crucial. Although knowledge management and processes have already been widely analyzed, research on harvesting tacit knowledge in virtual educational environments is still rare, in particular regarding the use of intelligent tutor systems for knowledge management processes. Therefore, the central question addressed in this paper is, how university knowledge processes concerning tacit knowledge can be supported by intelligent systems, such as bots and tutor systems.

KEYWORDS

Virtual Teams, Tacit Knowledge, Education, Learning Environment, Intelligent Tutor Systems, Educational Bots

1. INTRODUCTION

Universities work on adapting to the needs of a new generation of students. And new technological solutions provide efficient environments for teaching a growing student body, as well as enabling mobile learning. Especially studying mobile and remotely and forming virtual teams (VTs) allows students to integrate their studies into their lives while still being able to choose from rich options of universities and fields of study (Benson & Samarawickrema, 2009). Studying in VTs induces new chances and challenges for learners and lecturers alike regarding the processing of knowledge. In this paper, we focus on virtual teams as an option for organizing knowledge work in teaching and learning processes and consider the ensuing consequences for capturing tacit knowledge (TK). We want to understand the mechanisms of processing the valuable but elusive TK in an individual knowledge environment, such as in the context of mobile academic learning processes. When focusing on virtual work, the deployed information and communication technology (ICT) plays a major role. Therefore, we aim at deriving guidance for how to manage TK in the knowledge processes of virtual teams in a university learning environment with a special focus on deploying bots and intelligent tutor systems (ITS) as technological enabler. Thus, we concentrate on how these technologies relying on artificial intelligence can support these processes. As a consequence, we aim to answer the following question:

How can bots and ITS support the processing of Tacit Knowledge in a virtual university learning environment?

In order to answer the question, knowledge processes regarding TK for virtual teams are analyzed (Chapter 2). A framework and approaches for knowledge processes regarding TK in virtual learning environments (VLE) are constructed (Chapter 3). Finally, a discussion, possible limitations, as well as suggestions for future research are presented (Chapter 4).

2. CONCEPTUALIZATION

Tacit knowledge is regarded to enable people to create ideas through their experience of the past and anticipation of the future. This ability is crucial for developing advanced and innovative ideas (Leonard & Sensiper, 1998). To show how to support knowledge management processes, in particular TK in virtual settings, the concepts of tacit knowledge, knowledge processes and virtual learning environment (VLE) are presented in the following. Then the state of the art on managing TK in knowledge processes of VTs in university settings is described.

Virtual teams are not only used by organizations as an additional way of organizing work but as driver for meeting requirements of a future workforce and so staying competitive. That also applies for universities and the way education is designed. The options reach from partly virtual forms of learning processes (e.g., blended learning, flipped classroom) to a fully VLE (e.g., online mobile learning). Researchers strive to reveal the dynamics and dependencies regarding processing of TK in VTs, e.g., Alavi and Tiwana (2002) as well as Leonard and Sensiper (1998). Being able to analyze and process knowledge in virtual teams is of major importance for modern mobile learning settings and thus requires further insights on how to support the processing of tacit knowledge in virtual teams.

Knowledge can be regarded as a construct that consists of both, tacit knowledge and explicit knowledge (EK), with varying proportions (Virtanen, 2013). A difference between tacit knowledge and EK is that explicit knowledge focuses on how knowledge is organized while TK focuses on practice, on how work is done. Examples of TK are experiences, strategic thinking, and ideas (Liu, et al., 2008; Martins & Meyer, 2014).

TK cannot always be passed on easily via written documents (Martins & Meyer, 2014) as educational media, human interaction is needed for creating, retaining and transferring TK in VLE. The ways of human interaction in VLE are different for virtual teams compared to traditional teams. In traditional teams, students meet during lectures and study groups and can learn from each other. ICT, as for instance collaboration tools (e.g., Slack), established video call applications (e.g., Adobe Connect), or intelligent tutoring systems (e.g., AutoTutor) preserve the support for gaining experience for mobile and distance communication and enable virtual teamwork (Schweitzer & Duxbury, 2010; Rossi & Fideli, 2012). Thus, knowledge related processes need to be designed differently, if the teams in focus work virtually, due to the nature of tacit knowledge and prerequisites of virtual teams and their ICT use.

Knowledge processes use knowledge as object of alteration. Many different concepts of knowledge processes are derived in literature. The distinction of knowledge processes into creation, retention, transfer and application is common (Fang, et al., 2014) and allows for allocating all knowledge related activities to these processes. EK uses structured elements, e.g., documents, to retain and transfer data (Liu, et al., 2008). These can be used directly or altered for subsequent use, following explicated rules. TK is "stored" individually in people as carriers, and does exist even if not recognized consciously (Stenmark, 2000; Diptee & Diptee, 2013). Here, the carriers are the students as well as the lecturers. Regarding the use of ICT, explicit knowledge is primarily represented by documented information, whereas TK is already involved through the ways carriers of the tacit knowledge actually approach and use the available ICT (Alter, 2010). *Creation* of tacit knowledge is the process of generating new knowledge (Hao, et al., 2016). Knowledge creation can as also be a conversion of already existing knowledge into new knowledge. These conversion processes are based on human interaction (Nonaka & Takeuchi, 1995; Liu, et al., 2008). Knowledge can be *retained* through holding on to students and lecturers (Leonard & Sensiper, 1998) and supporting the transfer of knowledge (Martins & Meyer, 2014). This applies especially to tacit knowledge, as TK cannot easily be stored detached from the carrier without prior conversion to explicit knowledge. This conversion includes, e.g., discussions and written documentation. Knowledge *transfer* refers to the transfer between applications by the same person or team and to the transmission of knowledge from one person or team to another (Argote & Ingram, 2000). Considering a VLE, knowledge is transferred between students as well as from lecturer to student. ICT, such as chat rooms and virtual classrooms support the transfer of knowledge within their VTs. Factors influencing the transfer of TK are, e.g., trust, reciprocity and organizational structure (Hao, et al., 2016). The process of knowledge *application* regarding TK in a university setting is presented by solving tasks or guiding fellow students (Kapur, 2008; Bohle Carbonell, et al., 2014). TK is crucial for being able to recognize limits of and gain new strategies for problem solving (Kapur, 2008; De Arment, et al., 2013).

These conditions are necessary for dealing with and making decisions within a fast-changing environment with unknown parameters (Venkitachalam & Busch, 2012).

The idea of using ICT for supporting tacit knowledge processes is discussed in literature (Venkitachalam & Busch, 2012; Butler, 2016). Insights conclude that ICT supports online communication with non-verbal information, like video-calls and in virtual worlds (Ketcha, et al., 2015). Another study finds ITS useful for supporting teamwork and collaborative problem solving to enhance shared mental models (Sottilare, et al., 2017). To follow up this discussion, Venkitachalam and Busch (2012) as well as Ketcha et al. (2015) state that empirical studies focusing on the connection between TK processes and ICT are required.

By enlightening the role of TK in a VLE, we aim to describe approaches for lecturers in universities who strive for transmitting TK via bots. The benefits of VLEs, e.g., independence in time and place, stand against the segregation between the learners as well as the learner and the lecturer. The more teaching happens online, the more flexible it can be, but the more not only physical but also psychic distance between the participants is inherent (Benson & Samarawickrema, 2009). Addressing this challenge, suitable educational methods for the use of bots for teaching is presented in the following.

3. EDUCATIONAL BOTS FOCUSING ON TACIT KNOWLEDGE

Regarding the main question, the role of bots in supporting tacit knowledge processes in VLEs is described in the following. The terms ITS and bots, as used here, differ in one important aspect: ITS have been used for about 25 years for supporting particular non-complex learning (Rossi & Fideli, 2012). Traditional ITS are currently being enhanced with machine learning technology, resulting in systems mostly (and here) called bots. Both belong to the cluster of Artificial Intelligence Tools (Rossi & Fideli, 2012) and are educational tools that can be used to enhance TK creation, retention, transfer, and application. To simplify reading and because all assumptions we make are valid for bots and ITS alike, we will now only use the term “bot” for both characteristics. In general, bots are computer programs that provide individualized instructions by being able to connect the user’s input with given information (Rossi & Fideli, 2012). They are deployed in diverse subject areas (e.g., algebra, medicine, law, reading), helping learners acquire domain-specific, cognitive and metacognitive knowledge. Some advantages are the immediacy and response-specificity of feedback, more opportunities for practice and feedback, an increase of learner control as well as individualized task selection (Ma, et al., 2014). The role of ICT becomes crucial when managing TK in virtualized knowledge processes. Figure 1 shows the relationships between the knowledge processes with respect to managing TK and the ensuing need to document and communicate knowledge in a virtual team setting. Documentation and communication can be done via bots. Insights on using bots for notably enhancing the creation, retention and transfer of TK are provided. Therefore, some existing educational approaches are introduced that are suitable for supporting TK-learning via ICT.

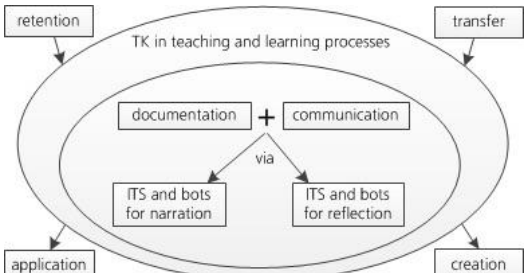

Figure 1. Documentation, Communication and the ICT Support as Enabler of Knowledge Processes

Students work together virtually and also need to share their knowledge and experiences virtually. The task of a lecturer is to prepare content and create possibilities of sharing TK in virtual teamwork to provide TK processes. In VLE, in which blended or mobile online learning defines the structures of teaching and learning, holistic contact is minimal (Falloon, 2012). Asynchronous communication as well as synchronous media-supported communication potentially lead to a lack of structure and intended meaning of information (Morgan, et al., 2014; Butler, 2016).

It is possible to enhance the existing knowledge system through information given by students, facilitators and employees with the proposed artificial intelligence tools. Narratives can be taught to the machine which is then able to build clusters from the information given. Bots have the advantage to be able to store knowledge that is encoded in spoken language, reducing the effort to express TK in written symbols (Lane & VanLehn, 2005): the need to have a continuous and consequent transparency of TK as well as the high effort for documenting TK (Rossi & Fideli, 2012, Bastiaens, et al., 2014). The systems are also able to recognize patterns in the narrations and store the respective information. This mechanism simplifies the search for information by assigning patterns found in an inquiry to patterns of stored information automatically. As a consequence, the transfer of TK from a database to a person and the awareness for and retrieval of existing knowledge can be supported (Rossi & Fideli, 2012). In addition to this, students teaching an avatar (teachable agent) supports the students' reflection of their knowledge and their skills to explicit meaningful patterns and converts TK to EK (Pipitone, et al., 2012). This also supports the students in being aware of the limitations of their own thinking and the willingness to communicate and reflect on competencies and limitations in, e.g., VTs which again supports TK processes (De Arment, et al., 2013). Though these are all valid advantages of using bots in academic teaching, the effort of developing such a setting and the necessity of working in an interdisciplinary team, should not be underestimated (Sottilare, et al., 2017).

4. CONCLUSION

TK proves to be a valuable but elusive resource in knowledge processes of virtual teams in university learning environments. All four identified knowledge processes are recognized to be a challenge for these VTs. But these challenges can be addressed by educational and technological solutions for academics as shown in this paper. Opportunities for enhancing the processing of tacit knowledge by applying educational methods on bots were presented in order to provide guidance for lecturers as well as starting points for future research on how to process knowledge in virtual teams, especially in VLEs.

Challenges occur driven by the degree of virtuality concerning knowledge creation and transfer. These can be approached by using bots for storing and sharing experiences. A limitation of this paper is the missing empirical foundation regarding the influence of ICT on tacit knowledge-processes. Further research is needed to determine the impact of an educationally sound designed bot.

In order to support learning and cooperation, students must be aware of the limitations of their own knowledge (Nonaka & Takeuchi, 1995). In this regard, the use of intelligent systems, such as bots, has a high potential for supporting students in their individual reflection. They can be designed to support transfer of TK, and also the creation of new knowledge through collaborative problem solving (Kapur, 2008). For the next steps, we see a high demand for further research that may elicit which combinations of ICT and educational methods are most effective for supporting knowledge processes for virtual teams in VLEs.

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