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Discussing two new approaches to analyze knowledge Construction in TEL environments

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Abstract

The study of collaborative knowledge building processes in Technology Enhanced Learning (TEL) environments is an important research topic in the field of Education and the Learning Sciences. In the last five years, the emergence of new technologies and especially their introduction and implementation in educational practices has brought along new challenges to the study of such processes. In this respect, this study searched for new analysis schemes developed in the last five years, focusing on asynchronous communication groups. The present paper details the literature search conducted and discusses two new approaches to analyze knowledge building in TEL environments.

Keywords: collaborative knowledge building, content analysis, analysis schemes.

1. Introduction

Research on collaborative learning in Technology Enhanced Learning (TEL) environments often focuses on measuring and evaluating the group processes, in addition to the group product. Collaborative learning can be a very powerful and effective way of learning, however, collaboration as such does not necessarily warrants good learning experiences (Vonderwell, 2003). Therefore, researchers often want to study the collaboration processes in detail.

Five years ago, an attempt was made to provide an overview of content analysis schemes employed for analyzing collaboration in asynchronous discussion groups (De Wever et al., 2006). Now, five years later, we deem it might be time to have a look at how the research field has further advanced – especially because both TEL practices and the related research has expanded fast, reinforced by the development of new technologies that have found their practice in the field. Therefore a new overview could be of use. The present paper focuses on addressing newly developed analysis schemes in the last five years. We especially expanded our search towards adaptive schemes aiming to analyze newly emerged (web 2.0) collaborative applications, such as wikis, blogs, etc.

2. Method

In order to accomplish such overview, a literature search was conducted in September 2010 in different international online databases: i) ISI Web of Knowledge, ii) ERIC, iii) ScienceDirect, iv) CSCL, ICLS and ECTEL proceedings. Search terms were limited to publication dates ranging from 2005 and 2010 and to the topics Computer Science and Education and Educational Studies. Terms used in the search included content analysis OR interaction analysis AND knowledge construction OR knowledge building. All identified documents were examined and those that were relevant were retrieved for inclusion in the review. In total, 26 studies were selected to be studied in detail.

From these studies, a large majority reports the use of existing schemes or the combination of different ones. Only two studies proposed new schemes and approaches to content analysis. They furthermore suggest renewed directions in this field of research in order to examine collaborative knowledge building in emergent asynchronous communication spaces. In the scope of this short paper, we selected these two analysis schemes to discuss in detail. The first one deal with analyzing knowledge building processes in wikis and the second one has a specific approach combining content analysis and visualization of patterns of interaction.

3. Results

In Table 1, an overview of the schemes is presented. It includes the communication environment that comprised the study and the theoretical background underlying the proposed content analysis scheme, in addition to the unit of analysis chosen to carry out the codification process and the type and level of inter-rater reliability reported. Below, both approaches are discussed in detail.

Table 1. An overview of the context of the studies and the analysis schemes developed.

Study	Peters & Slotta (2010)	Yap & Chia (2010)
Communication environment	Wiki	StudyWiz - LMS
Theoretical Background	Knowledge Communities Inquiry	Social Constructivism
Unit of analysis	Transactions	Message
Type of inter-rater reliability	Not reported	Holsti's (CR) Cohen's (K)
Level of inter-rater reliability	Not reported	CR 0.91/ K 0.93

3.1. Peters & Slotta (2010)

Peters and Slotta have been studying collaboration and knowledge building in a high school biology curriculum (Peters & Slotta, 2010ab, 2009). The curriculum design is based on the Knowledge Community and Inquiry model (KCI) developed by Slotta (2007), which “combines collaborative knowledge construction with scripted inquiry activities to target specific curriculum learning objectives” (Peters & Slotta, 2010a). Furthermore, it resorts to a community wiki to support its learning and communication environment.

Although the use of wikis in education is still a relatively recent development, and the formal research literature on the subject is limited, wikis are considered tools that promote collaboration, students' engagement, learning advancement and knowledge building (Cole, 2009; Cress, 2008; Judd, Kennedy & Cropper, 2010; Sheehy, 2008). Research on the content analysis of wikis built collaboratively in educational settings is also limited and so, as authors put it, “there are no accepted guidelines for analyzing wiki contributions” (Peters & Slotta, 2010b).

As an attempt to provide a framework to examine students' knowledge contributions to a wiki Peters & Slotta proposed a new coding scheme. They established their unit of analysis as “individual transactions”, i. e., actions that may include “the distinct changes to a wiki page that occur during authoring” (Peters & Slotta, 2010b). They coded all the students' transactions made to every version of the wiki according to: i) the type of transaction: move, add, delete and/or format, and ii) the type of content: text, image, internal and/or external link. Within each type, categories were applied as referred. Further coding was applied to text-based transactions. The ones performed on a classmate's text were coded as “peer” and transactions on one's own text were coded as “self”.

To study knowledge building activity in the wiki, authors wanted to find out how many transactions were coded as “peer” and “self”, in order to establish levels of collaboration and contribution to the wiki. They found that from the total number of text-based transactions (269), 44% were peer-based and 56% were self-based, constituting a roughly equal number of transactions according to “belongingness”. To further analyze the impact of the knowledge building activity, authors divided students into “low contributor students” and “high contributor students”. Then, they compared scores of the pre and post-test ran before and after the activity. Scores from the pre-test “were not statistically significant”, but post-test scores “suggest that students who are more involved with the knowledge

construction process are also engaging more with the subject content, resulting in higher test scores” (Peters & Slotta, 2010b).

Though authors refer that their research is still ongoing they refer important aspects that need to be taken into account when examining and designing knowledge building activities. One refers to insecurity aspects manifested by students and their concern about how they were perceived by their colleagues when participating in discussions. Another relates to the overload phenomenon that was described by students “as a feeling of being overwhelmed by the number of messages in the online discussions” (Peters & Hewitt, 2010). According to authors, this seems to affect the way students read and perceive online messages, which may limit their engagement in the progression of discourse.

3.2. *Yap & Chia (2010)*

In 2010, Yap and Chia put forward an attempt “to map the different stages of science knowledge construction as well as misconception in asynchronous discussion, with emphasis on how [secondary school] students collaborated with one another”. Based on a theoretical sample, authors analyzed the content of asynchronous discussion and its forms of interaction. In their article, authors propose a combination of quantitative and qualitative measures, claiming that the study of knowledge building in asynchronous discussions can only be study “through analysis of both the content of messages and patterns of interaction”.

To do this, authors developed the Knowledge Construction Message Map (KCMM) and the Knowledge Construction Message Graph (KCMG) – a set of tools that analyze both levels of knowledge construction and its frequencies. Levels of knowledge construction were classified according to the mapping tool KCMM, which we will look at more attentively due to its qualitative nature. The KCMM is a pyramid shaped visualization and mapping tool, which depicts levels of knowledge construction and misconception (see Fig. 1).

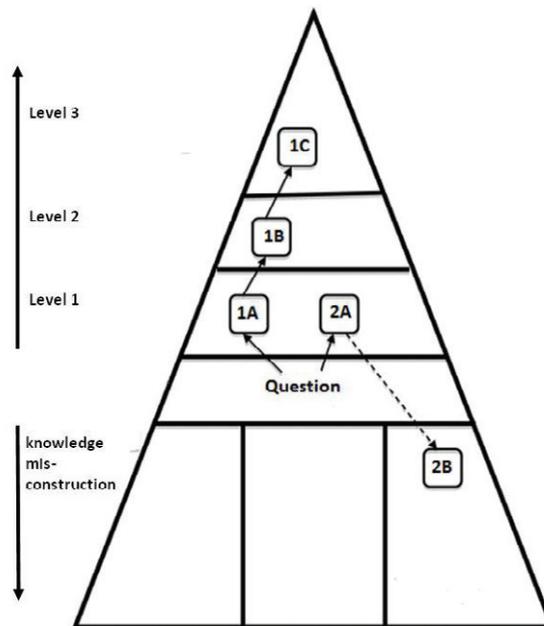


Figure 1. Knowledge Construction – Message Map (KCMM) developed by Yap & Chia

According to it, levels of knowledge construction or misconception are prompted by a question, usually a problem-solving question posed by the teacher or tutor students. Following the question, answers can be mapped

according to different segments. Segments above the question moment represent increasing levels of knowledge construction. Segments located below the question represent knowledge misconception or misconception.

Using a practical example, authors explain that student's 1 and 2 initial messages revealed understanding of the problem posed and so they were mapped into level 1 of the KCMM (1A and 2A). However, when posting a second time, student's 1 message content revealed an increased understanding of the question, whereas student's 2 message comprised misconception or misconception of the problem presented. Student's 1 message was mapped into level 2 (1B) and student's 2 message was mapped into the misconception segment of the KCMM (2B). Level 3 of knowledge construction was achieved when student's 1 message content revealed a deeper understanding of the topic being discussed (1C).

The authors argue that the differentiation of levels of knowledge construction "facilitates systematic comparisons across different groups or discussion" and enables the "move from a qualitative to a quantitative approach". The quantitative approach was studied using the number of postings delivered by students of each group and the frequency of students' levels of knowledge attained (cf. Yap & Chia, 2010).

In their study, authors conclude that although "asynchronous discussion did not necessarily lead to higher levels of cognitive development", students "dominated the discussion" and were "in charge of their own learning and scaffolding their understanding of scientific knowledge". They also conclude that despite constructions being built on other participants' ideas, misconstructions also occur, which demand attentive monitoring by teachers and/or tutors.

4. Discussion

This paper discusses two approaches to analyze knowledge construction in TEL environments. The first one (Peters & Slotta, 2010b) was chosen because it addresses the need for analyzing knowledge building in wikis. Wikis emerged in the mid 90's and have been used increasingly as educational environments since 2000 (cf. Augar, Raitman & Zhou, 2004). However, until now, there is no substantive body of research focusing on analyzing the collaborative processes by means of content analysis. In this respect, the concept of the "transaction" as a unit of analysis is functional, as well as the distinction between self and peer-edits, especially since students are often reluctant to change each other's text. The second (Yap & Chia, 2010) was chosen because it focused on both the content of messages and patterns of interaction.

The analysis of patterns of interaction, namely through the use of social network analysis (SNA) seems to be finding its way in the study of collaborative processes in asynchronous groups. It is being applied to study individual interactions in relation to the group and to provide a better understanding and accurate visualization of the contribution of such interactions to the group's collaborative knowledge building process (Yap & Chia, 2010; Heo, Lim & Kim, 2010).

Content analysis approach, such as the two approaches discussed in this study, can provide important information to researchers on the knowledge building processes of collaborative groups. Measuring these can be important in view of comparing different learning environments, tasks, supportive technologies and instructions. In addition, the retrieved information can also be important to "feed" the teacher, the tutor or instructor. For example, the number of misconceptions – or the ratio of peer to self edits – can be important parameters for assessing students' (or groups of students') level of knowledge building. In this way, learning can be better orchestrated by the teacher or instructor and learning activities may be better tailored towards the individuals' needs or towards a specific group of students.

Future research should focus on emerging learning environments and fine-tuning the schemes accordingly as well as the procedures, such as identifying units of analysis and reporting inter-rater reliability levels. More detailed schemes and procedures will not only help researchers to compare results of different studies, but could also be used to enable automatic analysis tools. These tools could provide both students and teachers with ad hoc information on the collaborative processes and provide teachers and students with specific recommendations towards the development of collaborative knowledge building.

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