Abstract: This paper reports some findings of our long lasting study in Finland, concerning the dialogic actions in web-based knowledge creation. Groups of professional teachers had an authentic dialogic task in an online environment. They had to create an artifact, an online learning process according to the DIANA model, as a web-document. Seven of the 14 small groups were successful in creating an adequate artifact, and the small groups were accordingly classified into successful and unsuccessful groups. In this paper the main results, based on qualitative and quantitative analysis, are reported. They show how the successful and unsuccessful groups differ clearly and significantly in certain dialogic actions. We claim that the results are promising.

Introduction

It seems to be rather difficult to foster genuine interaction in online learning. Generating effective online discussion and equal participation patterns in collaborative learning are the central difficulties and students do not, as is often assumed, generate ideas and solve problems together easily (see e.g. Guzdial & Turns, 2000; Järvelä & Häkkinen, 2002). On the other hand, according to many researches (see e.g. Vygotsky, 1962; 1978; Salomon & Perkins, 1996), in-depth learning demands social interaction, and knowledge creation is fundamentally a social process (see e.g. Paavola, Lipponen, & Hakkarainen, 2002). Interaction between peers and experts is an important part of any kind of learning environment (Brown, Collins, & Duguid, 1989). Expertise develops especially in a community of participants whose competency levels differ from one another (Lave & Wenger, 1991). Bakhtin (1984, p. 110) puts it elegantly: “Truth is not born nor is it to be found inside the head of an individual person, it is born between people collectively searching for truth, in the process of their dialogic interaction”.

The co-construction of knowledge via dialogue (Tella & Mononen-Aaltonen, 1998) is, however, possible in online environment. Since the social interaction and dialogue stressed by Vygotsky and others is of central importance in learning, it cannot be ignored in virtual learning environments either, if the aim is to construct or create knowledge and strive for versatile and in-depth learning results (Brown & Campione, 1996; Salomon & Perkins, 1996). If the students working in online environments change their presumptions concerning dialogue with others and the others as a source of information and understanding (Burbules, 1993), online learning may develop in a new and better direction. The teacher and the learners need skills in dialogue, so that shared knowledge creation and reflection can take place. This kind of dialogue is in no way a given. (Bohm, 1996; Isaacs, 1999).

The purpose of this paper is to show some of the crucial dialogic actions, which are fundamental in co-constructive knowledge creation in an online learning environment. In this study, small student work groups that were successful in co-constructive knowledge creation were compared with unsuccessful groups. The success of the groups was determined on the basis of the learning process and the constructed artifact, which was a web document. Using extensive empirical data, this paper describes the dialogic actions that differ significantly between these groups.

Knowledge creation in dialogue
The approach in our study is that knowledge is created and constructed in social interaction. Knowledge is constructed and it gains personal and culture specific meanings in everyday situations and discussions. According to Lave and Wenger (1991), the precondition for pedagogically valuable experience is that the experience is not a set of mental images of one person, but, first and foremost, multidirectional interaction and dialogue in a community. In practice, there are already remarkable examples of how shared knowledge creation could be possible in organizations (see e.g. Nonaka & Takeuchi, 1995) and in work teams (see e.g. Engeström, 1999). This kind of authenticity is also the point in online learning, because it provides the students with the chance for creating knowledge in the context of real world and personally meaningful problems (see Reeves, Herrington & Oliver, 2002; Shaffer & Resnick, 1999).

According to Paavola, Lipponen, and Hakkarainen (2002), “The Knowledge-Creation metaphor of learning means that learning is seen as analogous to processes of inquiry, especially to innovative processes of inquiry where something new is created and the initial knowledge is either substantially enriched or significantly transformed during the process. ... knowledge creation is a fundamentally social process.” The question is how this process will succeed among people. Following Vygotsky’s cultural-historical theory (1978), dialogue is seen as a key concept in teaching-learning processes (Tella & Mononen-Aaltonen, 1998), and thus dialogue could be understood as a crucial form of conversation in an online environment.

Dialogue is, according to Isaacs (1996; 1999), a unique form of conversation. In dialogue it is possible to improve collective inquiry processes, and to produce coordinated action among participants. Isaacs emphasizes that dialogue is not ‘mere talk’, and it is important to distinguish dialogue from the general forms of conversation. Bohm (1996) divides discourses into two types, dialogue and discussion. Discussion consists of many individual monologues, rather than shared reasoning and thinking. Isaacs (1996; 1999) points out that in dialogue people can begin to perceive, inquire into, and shift their tacit ways of thinking. It is possible to create completely new ways to formulate views, deal with different points of view, perceive the world and take action in it. Through dialogue, reflecting together on what we know and don’t know, we can act critically to transform reality (Shor & Freire 1987, p. 98-99). It seems to be as Mezirow (2000, p. 19) puts it when he talks about learning as transformation: it means elaborating existing reference, learning new frames of reference, transforming points of view, or transforming habits of mind.

Our definition of dialogue is based on Bohm (1996), Burbules (1993), Freire (1970), Bakhtin (1984; 1986), Isaacs (1999) and on our own research (Aarnio & Enqvist, 2001; 2002; 2003; Enqvist & Aarnio, 2003a), and the definition is as follows: Dialogue is based on equal co-construction of understanding. It is shared thinking and getting well acquainted with certain subject and activity. It is important to notice that in our definition of dialogue, dialogue is seen as a tool for co-constructive knowledge creation. Dialogue includes many critical actions, a failure in any of which can mean that the dialogue turns into regular discussion. The danger is present especially in online environments. Therefore, in order to get into dialogue it could be useful to see the abstract concept of dialogue as a number of different actions.

Hara, Bonk and Angeli (1998) analyzed the depth of processing in online discussions – surface or deep – within message posting. Their study showed that mere ushering to ask questions and to inquire is not enough to take the discussion into deeper level: the participants need help in developing this demanding skill. In the research of developing dialogue of the teacher students for communication and information technological environment (Aarnio, 1999), the criteria for analyzing interaction in online environment was created. The results, the found criteria of dialogue in online environment, were the following: opening and sharing of the incomplete thinking of one’s own, answering to the question of someone else, focused continuing of the utterance of someone else, inquiring, questioning concerning the whole utterance of someone else, inquiring question or a straight question to the others, opening the meanings of the key words in the other’s utterance, inviting others to participate, binding of one’s own speech act to the earlier utterance of someone else using the same expressed words, checking one’s own interpretations. (Aarnio, 1999.)

Aarnio (1999) noted that at the start of the development project the dialogue was mostly about opening one’s own thoughts, relating events in an informative manner. The others’ speech acts were taken into account only randomly and even important messages were overlooked with no reaction at all. The discussion was
characteristically undirected and the transitions from one topic to the next were shallow. The most unfamiliar interactive working methods were focusing on another’s speech acts and opening their meaning with open questions.

Dialogue as a form of conversation includes many critical skills or actions. In our research (Aarnio & Enqvist, 2002), we created the first version of the dialogic actions for transforming discussion into dialogue in online environment. The dialogic actions were later specified and reformulated in Aarnio & Enqvist (2003). To see dialogue as specific actions may help people to reach the competence of dialogue. In practice, it means that everyone is active, provides his or her contributions, is responsive, develops ideas, asks questions, opens the meanings of utterances, continues the utterances of the others, does not jump between themes, and is engaged in the often time-taking process of constructing shared understanding.

Methodologies

Context

For several years, we have used action research method, guided by an emancipatory interest, to conduct extensive research on online learning in the Finnish educational context. The objective has been to create a model of online learning, the central starting points of which are the focus on the learner, authenticity and dialogic knowledge creation. As a result of earlier research, a model called DIANA, abbreviation of Dialogic Authentic Netlearning Activity was constructed (Aarnio & Enqvist, 2002; Enqvist & Aarnio, 2003a; 2003b). The model provides a dynamic frame of reference that supports both students’ and teacher’s co-constructive knowledge creation in online learning environment. One of the cornerstones of the model is dialogic actions (Enqvist & Aarnio, 2003b). These dialogic actions lay a firm foundation for online learning. They activate, maintain and sustain shared thinking, problem solving and knowledge creation.

During autumns 2001 and 2002, we carried out two supplemental education courses called Dialogic Online Learning for the in-service teachers. The courses concentrated on online learning and dialogue based on the DIANA model. The professional teachers (n=49) from different substance areas took part in the courses. The study groups were 14 small groups (3-4 persons per group) in an online environment creating knowledge during the courses. The course was divided into three phases according to the periods of contact teaching. The second contact teaching period and the distance learning period were essential for the success of the education. In small groups, the participants constructed in the net a learning process, following the DIANA model, concerning a certain topic of their substance area. The learning processes that the participants constructed included step-by-step descriptions of the actions of students and teacher in the various stages of the process. The participants were given two months to finish this open-ended authentic task. Six (2+2+2) days of contact teaching were included in the education, but the actual online work on the discussion forums and group work areas of the WebCT learning environment occurred during the two distance learning periods that took place between the contact teaching days and that lasted for about a month. The small groups worked on this task and created knowledge on the discussion forums and group work areas of the WebCT learning environment. The work of the small groups, that is, the artifacts that were web documents, were supposed to be completed by the last contact teaching period.

Methods

Since the overall task in this course was demanding, only some of the groups managed to construct a complete online learning process that was assessed on the basis of the constructed artifact, i.e. a web document, and on the basis of dialogic actions that took place in the net. When the small groups were evaluated according to these criteria, it was possible, after the analysis of data, to divide them into two categories: Successful Groups (SG) and Unsuccessful Groups (USG). There were 7 SG groups and 7 USG groups.

The research data was comprised of 1387 discussion forum messages. The analysis focused on dialogic actions and was based on an apparatus constructed to classify dialogue (see Aarnio, 1999), which contains features of discourse analysis and conversation analysis. There were 19 variables that could be categorized as
dialogic actions and that were coded for every message in SPSS 11.5 for Windows program. Most of the variables could be categorized very unambiguously so that, if there were cases of dialogic actions, the value of the variable was 1, otherwise it was 0. In cases of some variables, the categorization process necessitated a very careful qualitative analysis. In the present paper that includes some interesting preliminary results, seven central variables are discussed. These variables seem to differentiate between the groups that, from the perspective of online learning, were either successful (SG) or unsuccessful (USG).

It should be pointed out that even though this discussion focuses on those results concerning dialogic actions that can be presented quantitatively, the in-depth foundation is always the careful qualitative analysis and interpretation of data. The focus of the present paper is on searching, on the basis of the analysis of the extensive empirical data (1387 messages), for the dialogic actions in relation to which the two groups, SG and USG, significantly differ from each other. When we wanted to find out which of the dialogic actions best differentiate between the groups SG and USG, Forward Stepwise Binary Logistic Regression Analysis and guiding Discriminant Analysis with Stepwise Method were carried out. These analyses revealed which variables were the strongest differentiating factors between the groups SG and USG. (These detailed analyses cannot be included in the present paper because of lack of space.)

Results

As was observed above, it could be concluded after the end of the study course and the analysis of the data, that there were 7 successful small groups (SG) and 7 less successful, or unsuccessful, groups (USG). The SGs had, in total, 986 messages and the USGs had 401 messages. It should be noted that the messages on the discussion forums in the learning environment formed so-called dialogue trees. The dialogue trees of the small groups always tended to form specific thematic wholes. There whole data (1387 messages) was composed of 247 different dialogue trees, of which 146 had been constructed by the SGs and 101 by the USGs.

Mean (SG) = 6.75 messages and the Mean (USG) = 3.97. This is also one indicative descriptor of the more active dialogic co-construction in the SGs, compared to the USGs.

When we started analyzing more carefully the dialogic actions that are critical to the success of the group activities, we observed that it was very important to study the development of the work groups in dialogic online learning as phases in time. Accordingly, the full work time of the small groups was divided into 3 consecutive phases: first phase (P1), second phase (P2), and third phase (P3). The total number of posted messages was in each phase as follows: P1 (SGs: n=292, USGs: n=163), P2 (SGs: n=358, USGs: n=115), P3 (SGs: n=336, USGs: n=123). In the following, the focus will be on some of the variables that emerged in the analysis as most differentiating variables.

Overall Group Activity (GRACT)

A very meaningful variable, from the point of view of the success of the groups, was their overall participatory activity, meaning their activity in posting messages onto the discussion forums with the necessary frequency and volume (No calculation details here for reasons of space). This activity holds up the right kind of work morale so that the process does not break off or become sloppy. The GRACT variable is standardized continuous between 0 and 1. It is a strong indicator of the differences between the SGs and USGs. Table 1 gives the values of the GRACT variable in phases P1-P3:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean (SG)</th>
<th>Mean (USG)</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0.47 (0.24)</td>
<td>0.22 (0.12)</td>
<td>14.74</td>
<td>p=0.000</td>
</tr>
<tr>
<td>P2</td>
<td>0.62 (0.29)</td>
<td>0.23 (0.09)</td>
<td>21.78</td>
<td>p=0.000</td>
</tr>
<tr>
<td>P3</td>
<td>0.59 (0.29)</td>
<td>0.25 (0.10)</td>
<td>19.03</td>
<td>p=0.000</td>
</tr>
</tbody>
</table>
The successful groups (SG) participated more actively during the whole process than the less successful groups (USG), whose participation was less active on the whole.

**Theme Jumping (JUMP)**

This variable describes jumping from one theme to another in the discussion forums. Variable JUMP = 1, when a participant posts a message on a theme that is not connected to the ongoing problem solving and which discontinues the dialogue and leaves it hanging. In other words, one jumps into another theme randomly, abruptly, and is unable to stay in topic. (Else JUMP = 0). Variable JUMP is a strongly differentiating variable and the greater the number of JUMP messages on the discussion forums is, the less successful is the dialogue.

In Table 2, the JUMP variable is observed in the three phases, P1-P3:

**Table 2. Means and Standard Deviations (in Parenthesis) of JUMP in the Phases P1,P2,P3.**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean (SG)</th>
<th>Mean (USG)</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0.05 (0.21)</td>
<td>0.18 (0.39)</td>
<td>-4.13</td>
<td>p=0.000</td>
</tr>
<tr>
<td>P2</td>
<td>0.06 (0.24)</td>
<td>0.23 (0.42)</td>
<td>-4.07</td>
<td>p=0.000</td>
</tr>
<tr>
<td>P3</td>
<td>0.04 (0.19)</td>
<td>0.24 (0.43)</td>
<td>-5.18</td>
<td>p=0.000</td>
</tr>
</tbody>
</table>

The successful groups (SG) stayed on theme through all there phases (P1, P2, P3) of the learning process, and were even able to further focus their work in the last phase. The less successful groups (USG) jumped in all three phases from one there to another and even more so towards the end.

**Answering Inquiring Questions (ANSW)**

If a message responded to at least one earlier question in a dialogue tree ANSW = 1, otherwise the value was 0. Thus, this dialogic action means that the message gives a clear answer to a question posed by someone else.

In Table 3, the ANSW variable is observed in the three phases P1-P3:

**Table 3. Means and Standard Deviations (in Parenthesis) of ANSW in the Phases P1,P2,P3.**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean (SG)</th>
<th>Mean (USG)</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0.33 (0.47)</td>
<td>0.27 (0.45)</td>
<td>1.32</td>
<td>p=0.186</td>
</tr>
<tr>
<td>P2</td>
<td>0.30 (0.46)</td>
<td>0.12 (0.33)</td>
<td>4.60</td>
<td>p=0.000</td>
</tr>
<tr>
<td>P3</td>
<td>0.35 (0.43)</td>
<td>0.14 (0.35)</td>
<td>5.23</td>
<td>p=0.000</td>
</tr>
</tbody>
</table>

The successful groups (SG) responded carefully to the questions that were posed on the discussion forums. The unsuccessful groups (USG) responded to questions in the beginning phase of the process, but the responses were more random in phases two and three. The difference was very significant.

**Delay in the Entries (DELAY)**

The value of the variable DELAY is congruent with the delay between the messages of one single member, i.e. the longer the dalay between the messages, the greater the value of this variable. Thus, this variable de-
scribes reversely the participant’s activity in the shared activities. Variable \textit{DELAY} is continuous and it was standardized between 0 and 1.

In Table 4, the \textit{DELAY} variable is observed in the three phases P1-P3:

**Table 4.** Means and Standard Deviations (in Parenthesis) of \textit{DELAY} in the Phases P1,P2,P3.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean \textit{(SG)}</th>
<th>Mean \textit{(USG)}</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0,040 (0,080)</td>
<td>0,064 (0,113)</td>
<td>-2,33</td>
<td>p=0,020</td>
</tr>
<tr>
<td>P2</td>
<td>0,030 (0,069)</td>
<td>0,059 (0,100)</td>
<td>-2,93</td>
<td>p=0,004</td>
</tr>
<tr>
<td>P3</td>
<td>0,039 (0,104)</td>
<td>0,090 (0,156)</td>
<td>-3,33</td>
<td>p=0,001</td>
</tr>
</tbody>
</table>

The members in the successful groups (SG) sent entries constantly throughout the process and the contributions were more frequent in the second phase of the process. The members in the unsuccessful groups (USG) delayed their entries and their number was the smallest in the third phase of the process.

**Focused Continuation (CONT)**

Variable \textit{CONT} describes the dialogic action in which a participant carries forward, or continues, in a focused manner from a phrase or message that some other participant has offered. Thus, if a message contains focused continuation to a previous message, \textit{CONT} = 1. If there is no focused continuation, \textit{CONT} = 0.

In Table 5, the \textit{CONT} variable is observed in the three phases P1-P3:

**Table 5.** Means and Standard Deviations (in Parenthesis) of \textit{CONT} in the Phases P1,P2,P3.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean \textit{(SG)}</th>
<th>Mean \textit{(USG)}</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0,44 (0,50)</td>
<td>0,31 (0,47)</td>
<td>2,70</td>
<td>p=0,007</td>
</tr>
<tr>
<td>P2</td>
<td>0,42 (0,49)</td>
<td>0,23 (0,42)</td>
<td>4,04</td>
<td>p=0,000</td>
</tr>
<tr>
<td>P3</td>
<td>0,48 (0,50)</td>
<td>0,37 (0,49)</td>
<td>1,98</td>
<td>p=0,049</td>
</tr>
</tbody>
</table>

The successful groups (SG) continued, in a focussed manner, in all phases of the process. The unsuccessful groups (USG) did not continue from each others’ statements often enough, especially in phase two (P2) and this produced difficulties because the phase two was central and critical to the success of the whole process (as the study revealed in many other points as well).

**Questions Relating to Problem Solving and Contents (QUCON)**

Variable \textit{QUCON} describes the dialogic action in which the participants make inquiring questions about the contents of the problem to be solved. \textit{QUCON} gains value 1 when the message contains such inquiring questions, and value 0 when it does not.

In Table 6, the \textit{QUCON} variable is observed in the three phases P1-P3:

**Table 6.** Means and Standard Deviations (in Parenthesis) of \textit{QUCON} in the Phases P1,P2,P3.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean \textit{(SG)}</th>
<th>Mean \textit{(USG)}</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0,37 (0,48)</td>
<td>0,30 (0,46)</td>
<td>1,51</td>
<td>p=0,132</td>
</tr>
<tr>
<td>P2</td>
<td>0,38 (0,49)</td>
<td>0,11 (0,32)</td>
<td>6,80</td>
<td>p=0,000</td>
</tr>
</tbody>
</table>
The successful groups (SG) made questions about the content area for the whole time, especially in the second phase. The unsuccessful groups (USG) inquired about the content area very little during the second phase (P2).

Separate and Disconnected Thoughts (SEPAR)

Variable SEPAR describes activity that disrupts dialogue, and in which the participants utter ideas and thoughts that are not related to the dialogue tree. SEPAR gains the value 1 when a message contains such disconnected thoughts. Otherwise, it gains the value 0.

In Table 7, the SEPAR variable is observed in the three phases P1-P3:

Table 7. Means and Standard Deviations (in Parenthesis) of SEPAR in the Phases P1,P2,P3.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mean (SG)</th>
<th>Mean (USG)</th>
<th>t-value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0,17 (0,38)</td>
<td>0,16 (0,37)</td>
<td>0,41</td>
<td>p=0,680</td>
</tr>
<tr>
<td>P2</td>
<td>0,08 (0,27)</td>
<td>0,32 (0,47)</td>
<td>-5,29</td>
<td>p=0,000</td>
</tr>
<tr>
<td>P3</td>
<td>0,08 (0,27)</td>
<td>0,14 (0,35)</td>
<td>-1,67</td>
<td>p=0,096</td>
</tr>
</tbody>
</table>

The successful groups (SG) had more disconnected thoughts in the first phase than the unsuccessful groups (USG). However, in the second phase of the process (P2), which was the most critical, the unsuccessful groups (USG) had markedly more separate thoughts than the successful groups (SG).

Conclusion

The professional teacher groups differed clearly in the web-based knowledge creation, and the small groups were separated into 7 successful and 7 less successful (unsuccessful) groups. Success was determined on the basis of the flow of the online dialogue, taking into account the whole learning process (divided into three phases) and the contents and practicality of the artifact that was the goal of the process. There were significant differences in the dialogic actions of the small groups, especially in the important and demanding second phase. The successful groups gained ground in their dialogue to handle and solve the problem, which resulted in new knowledge to the participants. The knowledge creation of these seven groups worked because the dialogues were based on such dialogic actions that supported the contemplation of and the work on a problem, as well as generated new ideas. Throughout the process, the dialogues produced material that took the task to new venues. On the other hand, the other seven small groups were not very successful in creating new knowledge, because their dialogic actions did not lead to knowledge construction and to the uncovering of new connections between the different aspects of the problem. The small groups were not able to contemplate the problems together, to continue each others’ thinking, handle the topics in a focussed and concentrated manner, respond to each others’ questions, and carefully receive each others’ contributions. Their work was more akin to separate monologues and it was fragmented in nature.

References


