Analysing Collaborative Processes and Interaction Patterns in Online Discussions

Canan Blake and Eileen Scanlon

Institute of Educational Technology, The Open University, UK; c.tosunoglu,e.scanlon@open.ac.uk

Abstract

This paper deals with collaborative, networked learning in a graduate distance learning course. We are interested in understanding how learning is affected by the quality of collaborative processes and the patterns of interaction in collaborative online discussion environments. For the purposes of this paper we are focusing on the interactions and collaborative processes occurring in an asynchronous online seminar which is about the design of teaching/learning software in the context of a science education course. The participants in the study, a total of nine students are mainly science teachers and they took part in this online seminar over a two week period to discuss the design of some selected pieces of software used for teaching and learning of science at various levels of schooling. In our analysis, we used a classification system validated in our earlier work and extended our approach for the purposes of this study using a rating scheme developed for assessing the quality of computer supported collaboration processes by other researchers (see Meier et al., 2007; and Rummel et al., 2011). Content analysis of the contributions to the online seminar showed that the two categories, namely 'acknowledging a fellow student by replying and or referring to their contribution' and 'motivation of students (indicated by a mention of their individual commitment to group task)' were the biggest categories. The frequency of 'joint knowledge building category' in this analysis indicates that students are committed to the task. During the activity they presented reports on their analyses with an aim to critically review the issues and themes arising form these analyses. When we compared this online seminar to a comparable one in the previous year, we noticed that both acknowledgment and motivational categories were much smaller. In addition to content analysis, we carried out an interaction analysis of the first online seminar to identify the patterns of relationship between students and visualise the relationship by using the connections between members.

This study may indicate the importance of motivation/individual commitment of students during a collaborative task and we are in the process of analysing other conferences in the same course to see the effect of motivation on the quality of collaborative learning/processes and the interaction patterns in the online seminar.

Keywords

Networked learning, CSCL, interaction analysis, distance learning, UK Open University

Introduction

The UK Open University (OU) has used online discussion tools to support adult learners since late 1980s (Macdonald, 2003; Mason and Bacsich, 1998; Mason and Kaye, 1989) and several researchers have investigated the use of these tools as a medium that supports collaborative learning at a distance (Littleton and Whitelock, 2005; McAlister, Ravenscroft and Scanlon, 2003; Jones, Scanlon and Blake 2000; Scanlon, Holliman, Newport and Blake, 2000). These forums provided us with invaluable data for investigating online discussions that involve different groups of students and topics over the years to identify factors that make online discussions effective.

It is a challenge for researchers in the area of networked learning or computer supported collaborative learning (CSCL) to decide how to analyse and make sense of the large body of discussion texts generated by participants in these forums. Many researchers have used methods including content analysis, interviews, observations, and

ISBN 978-1-86220-283-2

questionnaires to help us understand online collaborative practices among learners (Anderson, Rourke, Garrison and Archer, 2001; Crook, 1994; Strijbos , 2004; Wegerif, Mercer and Dawes, 1999).

In the area of CSCL research, interest has increasingly shifted from the outcomes and products of collaborative work towards the analysis of the processes of collaboration. This shift shows an attempt to gain understanding about the nature of productive joint activity and to identify interactional features that are important for collaborative learning.

A recent volume entitled 'Analysing interactions in CSCL' makes it clear that understanding how collaborative groups construct knowledge through joint activity is still a valid objective for CSCL research area. The reason for this is the fact that collaboration is beneficial to learning, however we, as researchers, still are not sure under which conditions it is successful and it may not always create intended learning outcomes. (Teasley, 2011, p.131) As collaboration requires participants to jointly construct knowledge and be aware of the group processes, we need to study interactions taking place among participants to understand what is going at the group level. As put forward by Stahl (2011, p.108) "understanding how a collaborative group as a whole constructs knowledge through joint activity in a CSCL setting is what sets the research field of CSCL apart from other approaches to the study of learning". In this context joint knowledge construction is demonstrated by:

- Flow of proposals
- Questioning
- Building common ground
- Maintaining a joint problem space
- Establishing intersubjective meanings
- Positioning actors in evolving roles
- Building knowledge collaboratively
- Solving problems together

Stahl (2011) also notes that studies with collaborative groups mainly focus on "quantitative correlations among variables - such as the effect of group size on measures of participation – rather then trying to observe groups' knowledge building processes" (p. 109). However in CSCL research the primary concern should be on the collective advancement of community knowledge and the improvement of ideas (Scardamalia, 2002).

The joint knowledge construction in an online discussion environment is also shaped by the implicit rules of cultural context. For example in our example of science teachers evaluating teaching/learning software in science, the rules and procedures of educational software evaluation will affect the content of students' discussion. Also students' prior knowledge (i.e. about usefulness of ICT in schools) and identity (as teachers of science with experience but aiming to improve and learn more from academics and researchers). For these reasons the context of students discourse has always taken a central role in our earlier analyses (Scanlon et al., 2000; Jones et al., 2000). Being aware of the context of the activity provides us with the tools to avoid missing or misunderstanding the processes of collaboration.

Finally, researchers have always paid attention to affective interactions in collaborative learning environments as it is considered necessary. For example Cutler (1995) suggests that "the more one discloses personal information, the more others will reciprocate, and the more individuals know about each other the more likely they are to establish trust, seek support, and thus find satisfaction" (p. 17). More recently Scanlon (2010) noted that "Socio-cultural views of learning have become prominent in recent years, emphasizing the importance of the individual and social nature of learning. Some have emphasized the importance of the priority given in this view to the '*evolving bonds between the individual and others ... (which) makes salient the dialectic nature of the learning interaction*' (Sfard, p.6)" (Sfard, 1998; cited in Scanlon, 2010).

The conditions for successful collaboration are therefore an important research area and the focus for this type of research should be the analysis of the process of collaboration rather than the outcomes.

Background

ISBN 978-1-86220-283-2

In this research we extended our earlier classification of collaborative processes after a brief review of literature. One of the studies in this area (see Meier et al., 2007; and Rummel et al., 2011) provided us with a rating scheme that matched quite well with our earlier research (Jones et al., 2000) and we were able to extend our analysis by adding one more category to our classification. The extended rating scheme by Meier and Rummel and associated aspects/dimensions of this scheme are presented below:

Communication: sustaining mutual understanding, collaboration flow
Joint information processing: knowledge exchange, argumentation
Coordination: structuring the problem solving process
Interpersonal relationships: cooperative interaction
Motivation: individual task orientation

In this scheme *communication* is about establishing a common ground and ensuring shared concepts, assumptions and expectations are mutually shared. Participants talk at the same level as the others and show evidence of understanding. *Joint information processing* is pooling and processing the complementary knowledge in a process of group-level. This way participants benefit from each other as a resource for problem solving and learning. Information can be pooled by eliciting information from others or externalising one's own knowledge. *Coordination* rating is related to time management and also task management where applicable. *Interpersonal relationships* rating is about the reciprocal relationship among participants, in an equal manner. And finally *Motivation* is the individual motivation and commitment of the participants to the collaborative task.

In addition to collaborative processes, we need to investigate the participation patterns and degree of participation by learners. The change in participation patterns over time is important in understanding collaboration processes and communication. In order to see the patterns of participation we need to analyse the interaction relationships among participants. This in turn would help understanding participants' activities and contextualise conclusions and interpretations better in these environments.

In this paper we will present how interaction analysis can be used, and provide an example analysis for an online conference in the context of a graduate distance learning course in science teaching.

Course and the task

This course investigates key issues in teaching of science and the subjects covered include influence of theories of learning, the purposes of science education and using information and communication technologies to support learning. The course is aimed at anyone engaged in teaching science at any level, and science graduates seeking a better understanding of science education.

Study materials include course books, other printed materials, audio and visual materials on DVD-ROM, online forums and a dedicated website. Most of the tuition is conducted electronically and students are expected to take part in moderated and informal online forums. These online discussion forums provide tutorials for this geographically distributed student population and opportunities for academic, administrative and social communication. Academic conferences related to specific parts of the course, called seminar conferences, provide students with opportunities to contribute ideas and questions to debates facilitated by associate lecturers. Each of these asynchronous conferences has a different time scale, ranging from the entire duration of the course (32 weeks) to two-day intensive activities. The seminar conference we focus on in this paper is the third block seminar (there are 4 Blocks of study in the course), it lasts two weeks and there are three stages to the activity. The discussion starts over a weekend with students posting their report (about 250 words) on a piece software they have chosen to examine. This is the first stage. In the next few days, students read the reports posted by their fellow students and try to get a feel for the range of examples that they will be discussing. They try to draw out themes and issues related to learning activities, affordances and design of their chosen example rather than picking up on details of content. They also are asked to send a design analysis of their chosen example based on the four design elements (media choice, structure, interactivity, presentation). In this stage (stage two) they don't have too much time to cover all these aspects so they are asked to focus on the most important aspect for them and their report which needs to be sent in the second half of

ISBN 978-1-86220-283-2

the first week, is again limited to 300 words. Stage three is the discussion of the design reports and the issues arising and takes all of the second week and students are encouraged to send a brief concluding statement. The online seminar is not assessed directly, but the topics covered are related to one of the course assignment.

Before the start of the seminar students are provided with instructions regarding contributions to the seminar and some reminders about the online code of conduct (called netiquette at the OU). Although participation in these seminar conferences is encouraged, attendance is optional. This is the students' main opportunity for online collaboration on the course.

In this online seminar there were 9 students. They sent a total of 71 contributions and there were 2 other messages one from the course manager and one from the tutor regarding the activities for the online seminar. Most of the students were teachers in schools (the total number of words in the seminar was 18K).

Methodology

In this study we are exploring collaborative actions in the two-week online seminar dealing with design analysis of teaching/learning software. In order to do this we first performed a content analysis of all the contributions in the online seminar. Content analysis is a reliable method for labelling and classifying content into theoretically meaningful set of categories that is used to investigate benefits of online collaborative learning (Rourke et al 2000; Strijbos et al 2005). We based our classification on our earlier work (Jones, et al., 2000; Scanlon, et al., 2000) and validated and extended it using the rating scheme by Meier and colleagues for assessing the quality of computer supported collaboration processes. (See Meier, et al 2007; and Rummel et al 2011). In these analyses we took the whole message as the unit of analysis as suggested by Rourke et al. (2001). They suggested that the message unit is the most reliable and practical unit to use because it combines the flexibility of the thematic unit with the reliable identification attributes of a syntactical unit.

In this paper we will not present the results for content analysis of design analysis related academic content but will focus on the collaborative action categories as follows:

Joint knowledge building: presenting and defending a position by giving one or more rationale or justifying the opinion by explaining it (comparable to Meier's communication/sustaining mutual understanding category).

Asking questions or dialogue extension prompts: asking questions, sometimes not actually to get and answer but to prompt fellow students to think/contribute on a certain subject (comparable to Meier's communication/sustaining mutual understanding category).

Supporting the argument with a reference and or an example: giving an example or providing a reference to clarify the topic under discussion.

Acknowledging/replying referring to another message: referring to/extending on ideas in a fellow students contribution (reciprocal/cooperative orientation in Meier's classification; 'interpersonal relationship' category in Meier's extended rating scheme).

Instructions/information: contributions that are related to running of the collaborative activity ('coordination' category in Meier's extended rating scheme)

Motivation and commitment: contributions referring to participants' individual motivation and commitment to the task (taken from Meier's extended rating scheme; not used by us in earlier work)

Case study analyses

In coding the messages we chose to mark each contribution with as many of the categories as applicable. As a result, these categories are not mutually exclusive. Figure 1 shows the distribution of collaborative processes in the online

ISBN 978-1-86220-283-2

seminar. The number of messages with a mention of the contributing student's individual commitment to the activity and/or their personal motivation is one of the biggest categories in this chart. This is important and it provides a very lively discussion. In addition there is a lot of acknowledgement of and replies to other contributions. This shows a high level of interaction. (Some of the students knew each other from earlier seminars on the course).

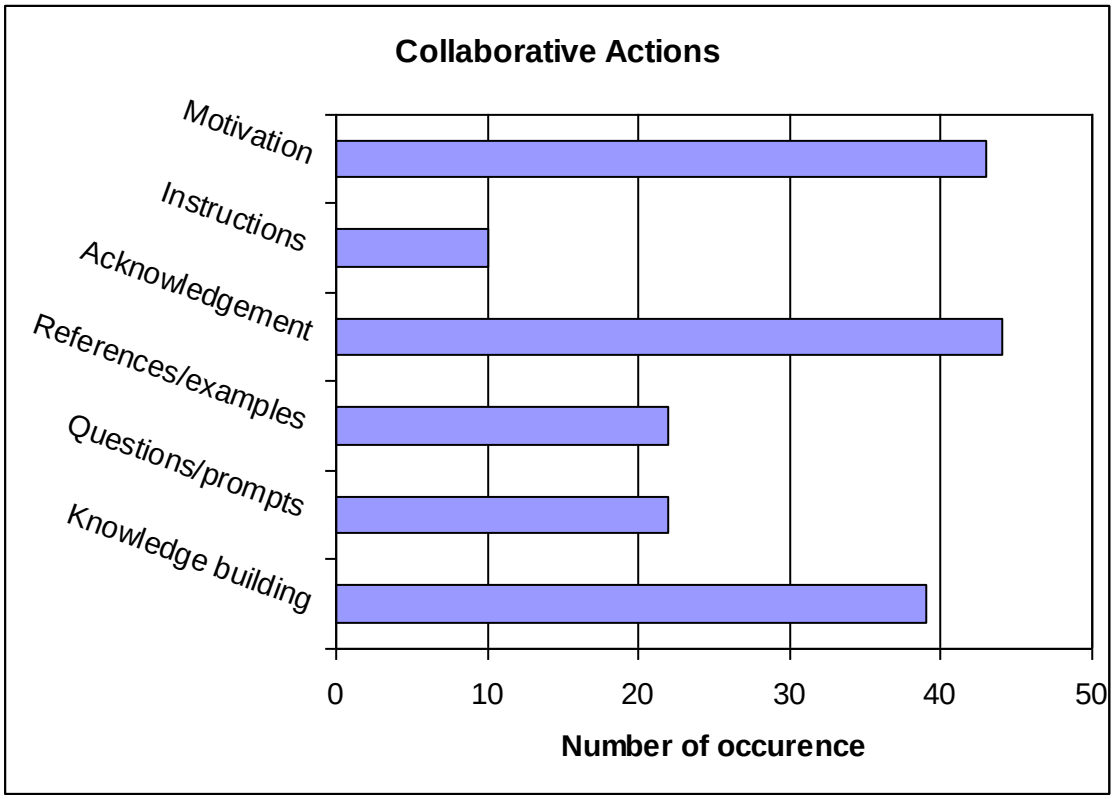

Figure 1. Content analysis results for collaborative actions.

Example

The examples below are sections from students' messages (not real names) showing the coding for collaborative actions categories. We did not include an example for **Information/instructions** category.

> *Hi Lyn, I enjoyed reading your initial report on the Global Warming site, and have subsequently explored the site for myself. I was a little overwhelmed by the amount of information, although I agree with you that it supports the learning objectives as listed and is pedagogically relevant.*

The above section from a contribution would be marked in the categories:
Acknowledging/replying referring to another message
Motivation and commitment

> *On the subject of interactive white-boards (as a slight diversion) , is anyone else of the opinion that their use shifts considerably the broad focus of educational software since participation in the ICT*

ISBN 978-1-86220-283-2

experience is less of a one to one and more of a one to many. How is this translated into software design regarding 'feedback'? Just a thought!

The above extract from another message would be marked in the category **Asking questions or dialogue extension prompts** whereas the section below would be marked in the category **Supporting the argument with a reference and or an example:**

Exercises could include 'Design a three course meal for a hedgehog; mollusc starter, anthropod main course and worm desert' (a more interesting version of 'sort the minibeast'). Feedback should be provided only on completion of the exercise, so that it cannot be completed by trial and error. Users could also be asked to attempt to build the food chain…

Finally messages containing sections similar to the below text would be marked in the category **Joint knowledge building:**

It was interesting to see that Planet 10 and Global Warming used, in the first case, great graphics and text boxes and in the second case 'mainly text and diagrams'. They almost became transmission teaching because students had to read information, but didn't have a lot to do with it in the actual package. This seems a pity when so much more could have been.

In order to compare this online seminar with another one we chose the same conference, in the same course with the same tutor the previous year and briefly analysed the distribution of collaborative actions. This second online seminar had a total of 37 (7 of them from tutor) messages with 10 participants. A couple of students had difficulty in joining the seminar due to unexpected demands on their time but still there were 3 other students who only sent the initial report and did not contribute at all, after that. Remaining students send their reports mostly as required but only one participant acknowledged another student's contribution regarding the task. Although academically their task was done, there was almost no interaction/collaboration among participants. The few other acknowledgements were about the coordination of the activity. As the interaction among participants was almost non existent we decided to carry out the interaction analysis only on the first conference. It is interesting to note that these two student groups were given the same instructions about carrying out the task and applying the online code of conduct but their behaviour, especially in terms of acknowledging other students contributions is so different. Earlier we mentioned that in the group with a substantial number of interactions, some students knew each other from previous seminars on the course. There is no reason to believe that the situation would be different for the second group with very few interactions as they would have worked in the same groups in earlier tasks and had opportunities to get to know each other.

Interaction analysis

During the content analysis, students contributions were also marked when they referred (either explicitly by using reply facility or naming the fellow student(s) or implicitly by referring to the ideas in a certain contribution) to another message to produce a representation of the interactions in the online seminar. This analysis is based on the actual content of the messages rather than automatic reply feature of the online seminar software.

To explore the interaction patterns more closely we prepared a pictorial representation of the conference following social network analysis (SNA) approach (deLaat et al 2007). The links in the interaction map represent students commenting, quoting, replying or adding to another contribution in the seminar. This analysis showed that of 71 student messages 61 was linked to other messages with one or more links. Figure 2 present a fragment from the interaction map illustrating some features of conducting this type of analysis. This fragment shows that in message number 24 Bea refers to Lyn's contribution (regarding the structure of her design analysis task). In turn Rob refers to Bea's contribution in message 28. The topic of this acknowledgment (although it is not possible to say this just by looking at the interaction map) is the excellent contribution done by Bea and common threads emerging about the pieces of software being examined. Rose also acknowledges Bea's and Rob's contribution and mentions that their

ISBN 978-1-86220-283-2

contribution ‘made her to go and examine these pieces of software for herself’, although it was not required by the course. The content of the messages was not included in the map because the number and the rich content of the messages are difficult to present in one page.

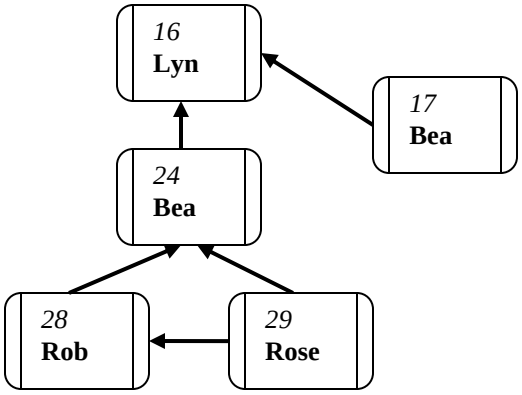

Figure 2. An illustrative fragment of the full interaction map.

Conclusions

The use of content analysis and interaction analysis together in this study has been shown to be beneficial as a way of evaluating the educational effectiveness of an online discussion.

The content analysis of these conferences provided us with an understanding of what issues students were talking about, how they were using the course materials to further their learning, how collaborative their activities were. This also provided evidence of learning processes occurring in the online seminars in this graduate course. We were able to label messages that contribute to group task by providing knowledge, references, examples, questions and explanations. Our interaction map (Social network analysis) on the other hand provided us with information regarding the degree to which participants had a balanced discussion, to what extent does the interaction change over time and a visual representation of connections (and non-connections) among participants. This insight into the internal dynamics of the seminar enabled us to see who was talking to whom.

Our initial analyses in this study have shown that the reciprocal relationship among participants in an online discussion environment could be an important factor in enhancing the efficiency of joint knowledge building and other collaborative processes. This is in line with the social presence concept mentioned by Rourke et al (1999) which is the “ability of learners to project themselves socially and emotionally in a community of inquiry” (p 54). They propose that social presence supports affective and cognitive objectives of learning by instigating, sustaining and supporting critical thinking in a community of learners.

In order to investigate the direct effect of social interactions, motivation and individual commitment on collaborative processes we are now analysing similar conferences with the aim of understanding why the two conferences we analysed in this study are different from each other and what factor contributes to these differences.

We conclude that content and interaction analyses carried out on the actual messages can help researchers to understand processes taking place in collaborative learning environments.

ISBN 978-1-86220-283-2

References

Anderson, T., Rourke, L., Garrison, D. R., Archer, W.,. (2001). Assessing Teaching Presence in a Computer Conferencing Context. *Journal of Asynchronous Learning Networks*, 5(2). 1-17.

Clark, H.H. *Using the language.* Cambridge: Cambridge university press.

Crook, C. (1994). *Computers and the collaborative experience of learning*. Routledge, London, UK.

Cutler, R. (1995). Distributed presence and community in Cyberspace. Interpersonal *Computing and Technology: An electronic Journal for the 21st Century*, 3(2), 12-32.

de Laat, M., Lally, V., Lipponen, L. & Simons, R.-J. (2007) Investigating patterns of interaction in networked learning and computer-supported collaborative learning: A role for Social Network Analysis. *International Journal of Computer-Supported Collaborative Learning,* 2 (1). DOI: 10.1007/s11412-007-9006-4.

Jones, A., Scanlon, E., & Blake, C. (2000). Conferencing in communities of learners: examples from social history and science communication. *Educational Technology and Society*, 3, 215–226.

Littleton, K., & Whitelock, D. (2005). The negotiation and co-construction of meaning and understanding within a postgraduate online learning community. *Learning, Media and Technology*, 30, 147–164.

Macdonald, J. (2003). Assessing online collaborative learning: process and product. *Computers and Education*, 40, 377–391.

Mason, R., & Bacsich, P. (1998). Embedding computer conferencing into university teaching. *Computers and Education*, 30, 249–258.

Mason, R., &Kaye, A. (Eds.). (1989). *Mindweave: Communications, computers and distance education*. Oxford: Pergamon.

McAllister, S., Ravenscroft, A., & Scanlon, E. (2004). Combining interaction and context design to support collaborative argumentation using a tool for synchronous CMC. *Journal of Computer Assisted Learning*, 20, 194–204.

Meier, A., Spada, H., & Rummel, N. (2007). A rating scheme for assessing the quality of computer-supported collaboration processes. *International Journal of Computer-Supported Collaborative Learning, 2*(1), 63-86.

Rummel, N., Deiglemayr, A., Spada, H., Kahrimanis, G., and Avouris, N. (2011) Analysing Collaborative Interactions Across Domains and Settings: An Adaptable Rating Scheme. In S. Puntambekar, G. Erkens, and C. Hmelo-Silver (editors) *Analyzing Collaborative Interactions in CSCL: Methods, Approaches, and Issues*. Springer, New York.

Rourke, L., Anderson, T., Garrison, D. R. and Archer, W. (1999). Assessing Social Presence in Asynchronous Text based Computer conferencing. *The Journal of Distance Education*, 14(2), 50-71. Available at: http://www.jofde.ca/index.php/jde/article/view/153/341

Scanlon, E. (2010) Technology enhanced learning in science: interactions, affordances and design based research. *Journal of interactive Media in Education*, 2010 (8). Available at: http://jime.open.ac.uk/jime/article/view/2010-8 (accessed 19 January 2012).

Scanlon, E., Holliman, R., Newport, C., Blake, C. (2000). Communicating science: media, technology and distance learning. In: *Proceedings of the CCS conference*. London: Institute of Education. June. Available at: http://www.ioe.ac.uk/ccs/conference2000/papers/tpm/scanlon.html; last accessed 23rd August 2005.

Sfard, A. (1998) On two metaphors for learning and the dangers of choosing just one. *Educational Researcher*, 24(7):5-12

Stahl, G. (2011) How to Study Group Cognition. In S. Puntambekar, G. Erkens, and C. Hmelo-Silver (editors) *Analyzing Collaborative Interactions in CSCL: Methods, Approaches, and Issues*. (pp. 107-130). Springer, New York.

Strijbos, J. W. (2004). The effect of roles on computer supported collaborative learning. Unpublished Dissertation, Ph. D., Open Universiteit Nederland, Heerlen, the Netherlands.

Teasley, S.D. (2011) Thinking about methods to capture effective collaborations. In S. Puntambekar, G. Erkens, and C. Hmelo-Silver (editors) *Analyzing Collaborative Interactions in CSCL: Methods, Approaches, and Issues*. (pp. 131-142) Springer, New York.

Wegerif, R., Mercer, N., and Dawes, L. (1999) From social interaction to individual reasoning: an empirical investigation of a possible socio-cultural model of cognitive development. Learning and Instruction, 493-516.

ISBN 978-1-86220-283-2