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Modelling computer-mediated collaborative talk and action: a case study on ICT-based music composition in primary schools

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ABSTRACT: In this paper, the author describes an ICT-based collaborative learning model, namely *ComPLuS* (Computer-mediated Praxis and Logos under Synergy), through which peers' collaborative talk and action can be modelled. In this model, peers' dialogues are categorised into five types, ie disputational, cumulative, exploratory, operational and reflective, with each one corresponding to different types of spoken contributions. Moreover, actions are categorised as individual or joint and are used to evaluate the effect of computers on the collaborative activity within a pair. *ComPLuS* was used to analyse transcripts from videotaped observations of nine dyads (11 years) from three Greek primary schools. Their ongoing peer-to-peer communication and actions formed the research data. A mixed (qualitative and quantitative) analysis revealed that peers usually adopted cumulative and exploratory talk. The results suggest that the *ComPLuS* model captures the characteristics of peers' collaborative interactions during their shared discussions and actions, and can lead to a better understanding of the nature of computer-supported collaborative creativity.

INTRODUCTION

There is a positive notion that interaction around computers can afford a particularly productive method of learning [1-3]. Indeed, one of the clearest benefits of computer-based lessons postulated in the literature is the fact that Information and Communication Technologies (ICT) support new modes of learning, such as the collaborative type [4-6]. Stahl has pointed out: *sociocultural theories have been imported from cognate fields to suggest that cognition and learning take place at the level of dyads and/or groups as well as individuals* [7].

Various positions on this issue have been proposed and a number of theoretical perspectives have been recommended. In particular, the concept of communication, which can effectively facilitate learning conversations between learners in proximity, has been developed by examining how meanings and understandings can be shared by peers who construct knowledge by using language. In this manner, language is used in new and functional ways. Following this perspective, it is worthwhile investigating, from a sociocultural approach, learning as a language-based interactive process that can be subsequently and effectively affected by the use of computers.

Thus far, researchers have provided evidence of the potential value of computer-based talk among learners who work together towards a common task, thereby becoming able to develop an understanding through their collaborative conversation [8-11].

Emphasis has been placed on which types of talk are deployed during peers' computer-based collaborative activities that appear to be important and beneficial for the learning process [12-14]. As a result, there is significant consensus about examining the potential of collaborative talk in different subjects, such as literacy, mathematics, geography, chemistry and so on.

However, despite this emphasis, very little empirical research has been carried out on how technology can reinforce collaborative strategies, particularly in the context of music education with reference to the computer-based collaborative composition.

As a response to this deficiency, the current effort presented in this article introduces the *ComPLuS* (Computer-mediated Praxis and Logos under Synergy) model (*praxis*, *logos* and *synergy* are the Greek words for *action*, *talk* (word) and *collaboration*, respectively). The latter is based on a conception of *talk* and *action* (the term action was approached taking into account children's interaction with a music software (*Finale 2007* by MakeMusic, Inc.) when they composed together) as a tool for *thinking together*, with computer software being treated as a resource for organising and focusing children's involvements in compositional collaborative activities.

In this article, learning through computer mediation is considered not only as an individual construction developed when interacting with the computer, but also as a social construction developed within the whole learning activity. Thus far, models have been too simple to describe the complexity of collaborative learning that is based on the communication between learners through talk and action. Therefore, a framework has been created to describe:

- The level of spoken contributions and the talk types they lead to;
- The software-based actions as well as pupils' actions combined with the kind of decisions accompanied by peers' activities.

Additionally, the introduced framework illustrates a systematic approach that has the potential to explore and interpret pupils' computer-mediated collaboration without coaching before and during the collaborative session.

THE PROPOSED MODEL

The framework of grounded theory was adopted as a means to discover the potentially important variables of the *ComPLuS* model from systematically obtained and analysed data [15]. However, this perspective has advantages and disadvantages. On the one hand, a very detailed analysis gives full insight into the different aspects of pupils' talk involving many types of spoken contributions. On the other hand, it gradually increases the complexity of the model but reducing its manageability.

Two important aspects were taken into consideration to find a trade-off between these two opposing trends. These were the similarity and frequency of the spoken contributions. Initially, all different spoken contributions formed a separate category, labelled in MS *Word* documents of transcripts. Next, a grouping procedure took place based on the similarity of these categories, resulting in a re-labelling procedure when required. In addition, categories of spoken contributions that could not be placed within a group were examined for their occurrence across transcripts. In cases when they exhibited low frequency across pairs (eg they appeared only a couple of times in only one pair), they were eliminated from the list of potential categories of spoken contributions; otherwise, they formed a separate, new one. By the end, 28 spoken contributions were identified as the most essential and representative types (see Table 1).

The mapping of the identified categories of spoken contributions to talk types was based on their collaborative character. Wegerif and Mercer defined three types of talk, ie *disputational*, *cumulative* and *exploratory* [14]. Motivated by this categorisation, a grouping analysis took place to evaluate the collaborative characteristics of each spoken contribution type and, hence, classify it into the three categories. However, during the mapping procedure, it was found that two more talk types should be employed to account for all the identified spoken contribution types. To this end, *operational* and *reflective* talk types were introduced as an extension to the approach of Wegerif and Mercer [14]. Table 1 illustrates the types of collaborative talk based on *ComPLuS*.

Peers' activities were approached in a twofold manner. Initially, software-related actions were modelled as:

- AC-FEED: Action related to audio feedback provided from *Finale 2007*;
- AC-T/E: Action related to peers' engagement with a trial-and-error procedure with *Finale 2007*.

Next, peers' collaborative activities combined with the kind of decisions that accompanied peers' actions during the compositional process were examined. As a result, the actions were modelled as follows:

- AC-1: *Individual action* (individual action of one peer without contribution from his/her partner, either in the dialogue and/or the action level);
- AC-2: *Imposed action* (imposed action of one peer to the other, ie the opinion of one peer is ignored);
- AC-3: *Tacit joint action* (tacit action based on a joint decision between peers without providing any oral agreement);
- AC-4: *Explicit joint action* (explicit action based on a joint decision between peers accompanied by a spoken contribution).

A CASE STUDY ON MUSIC COMPOSITION

The *ComPLuS* model was tested on a music composition case study. Pupils aged 11 years of mixed gender were chosen from three Greek state primary schools. All had some basic computer skills and most were familiar with the simple use of word-processing software, ie MS *Word 2003*.

The subject of the collaborative task was a computer-based joint music composition; all pupils had some knowledge of musical notation and rhythm, and a basic experience of listening, performing, composing and appraising music within the classroom, but they had never previously written a composition using the specific music software involved in the study.

Table 1: Types of collaborative talk used in the *ComPLuS* model.

Talk Type	Definition	Indicative Collaborative Spoken Contributions
Disputational (DISP)	There is no evidence of consensus thinking	Short exchanges consisting of proposals as an offer with counter-proposals; disagreements; proposals as an imperative; proposals followed by an individual action
Cumulative (CUM)	There is some effort to build consensus	Proposals as an offer; proposals as a question; counter-proposals; joint proposals as an offer; agreements; comments; repetitions; confirmations; questions seeking assistance; questions seeking agreement; questions seeking confirmation
Exploratory (EXP)	There is evidence that peers debate and explore together to find the best solutions	Proposals as an offer are defined in this type of talk only if they were followed by an explanation, a clarification or an elaboration; proposals followed by an agreed action; disagreements followed by explanation; critique; clarifications; explanations; elaborations/elaborations (S) (involving elaboration with singing (for case studies in music)); questions seeking explanation; questions seeking clarification; questions seeking elaboration
Reflective (REF)	Peers engage critically and constructively expressing self-reflective thinking	Self questions; self elaborations
Operational (OPER)	Peers' utterances relating to operational transactions with regard to talk and software, respectively	Utterances about the task; utterances about the software

Observations of case studies were carried out, and video and audio materials were used to capture the complexity of the collaborative process. Pupils were asked to set up a melody to one of three particular lyrics that were composed by the first author formed in simple language and with a descriptive character working in pairs (see Figure 1).

Figure 1: Pupils working in pairs around the computer to compose a music melody.

In order to analyse the data, mixed methods were chosen that adopted both qualitative and quantitative approaches. After the data collection, a transcription process took place where all the videos were transcribed. During the next step, a textual analysis was adopted that offered an interpretation of what pupils had discussed during their conversation and developed through their actions. The next step involved a numerical coding of the parameters derived by the introduced model, followed by a quantitative analysis, which attempted to measure the frequency of spoken contributions and actions according to the categorisation of the *ComPLuS* model.

RESULTS AND DISCUSSION

Experimental results have shown that pupils were actively engaged in a dialogue during their common task, exhibiting a high number of spoken contributions per pair. Pairs' joint work was active enough, including a sufficient number of actions per pair (108 on average) and the AC-3 action type (actions based on a tacit joint decision between peers) was used most frequently during peers' mutual work (see Figure 2).

Additionally, it was found that pupils acted individually even when they deployed collaborative talk types. From a hierarchical perspective, talk types can be ranked (in a descending order of their frequency in pairs' dialogue) as CUM (cumulative), EXP (exploratory), OPER (operational), DISP (disputational) and REF (reflective). However, it was found that although the cumulative talk type dominated pupils' conversations, exploratory and reflective talk accompanied the activity of peers during their joint work, since a strong correlation (>0.7) of {EXP, REF} talk type group with actions was found (see Figure 3).

Lastly, it was noticed that the lead on collaborative talk did not mean the lead on joint action and that there was no guarantee that collaborative talk equated to joint action because it only correlated with actions AC-1 and AC-2, showing that the two talk types of EXP and REF affected only a peer's individual activity. However, a strong correlation between AC-T/E and AC-3 (see Figure 4), and between AC-T/E and {EXP, REF} talk type group (see Table 2) was found, indicating that the manipulation of software facilitated children's joint action and collaborative talk.

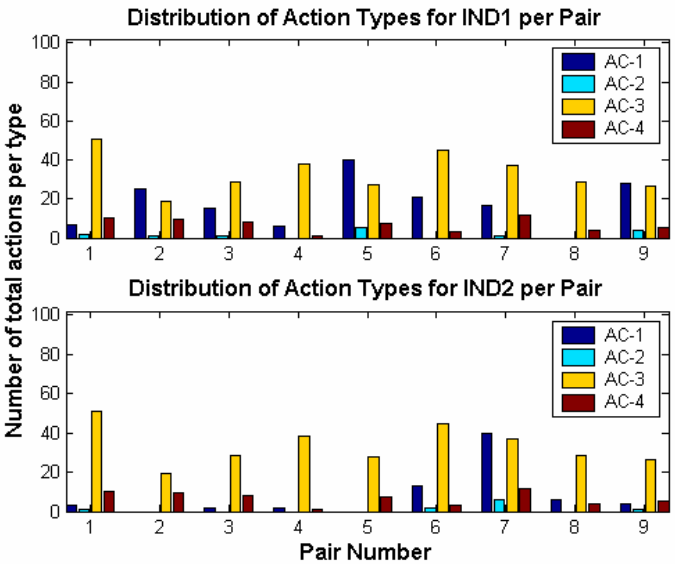

Figure 2: The distribution of the total number of action types for Pupil A (IND1) (top) and Pupil B (IND2) (bottom) for each pair. Action types: AC-1: individual action by one peer; AC-2: imposed action of one peer to the other; AC-3: action based on a tacit joint decision; and AC-4: action based on an explicit joint decision.

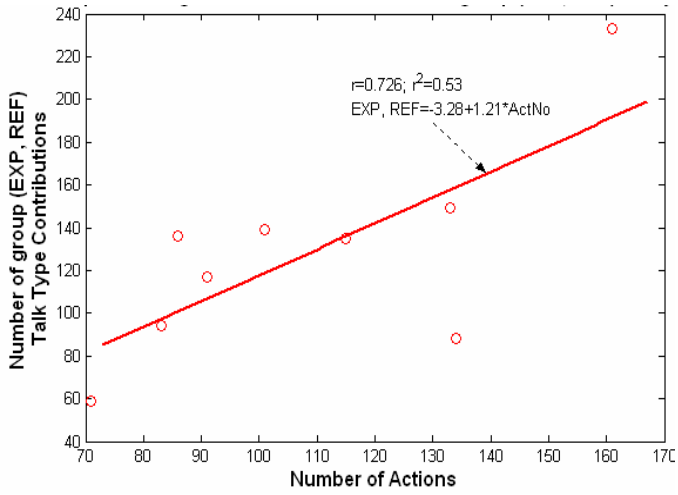

Figure 3: A scatter plot and regression analysis between the total number of actions (ActNo) associated with the group {EXP, REF} of talk type. r and r^2 denote the Pearson's correlation coefficient and the coefficient of determination, respectively.

CONCLUDING REMARKS AND FUTURE WORK

In this article, the author introduces the *ComPLuS* model and explores its modelling efficiency when applied to a music composition case study. Using the *ComPLuS* model, a means for classifying talk and action, which both give insight into the extent of collaboration, is provided. The *ComPLuS* model investigates the learning processes when children are actively involved in pairs in a computer-based compositional task by identifying a variety of spoken contributions that lead to different types of collaborative talk and analyses their actions while they manipulate score writing software and the decisions accompanying those actions during the compositional process.

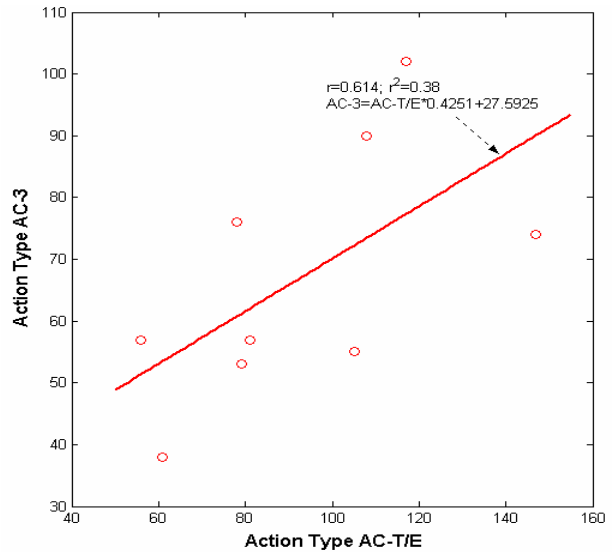

Figure 4: A scatter plot and regression analysis between AC-T/E (action related to trial-and-error procedure with the software) and AC-3 (joint action). r and r^2 denote the Pearson's correlation coefficient and the coefficient of determination, respectively.

Table 2: The correlation analysis results between the software-related action types and the associated talk type groups.

Group of Talk Types	Software-Related Action Types	
	AC-FEED	AC-T/E
{DISP, OPER}	r = -0.247 p = 0.522	r = 0.416 p = 0.265
{EXP, REF}	r = -0.071 p = 0.855	r = 0.750* p = 0.02 < 0.05
CUM	r = -0.251 p = 0.514	r = 0.448 p = 0.226
DISP: Disputational; CUM: Cumulative; EXP: Exploratory; REF: Reflective; OPER: Operational. AC-FEED: Action related to the audio feedback from *Finale 2007*; AC-T/E: Action related to peers' trial-and-error procedure with *Finale 2007*. *: Correlation is significant at the 0.05 level		

The findings justify the adoption of the sociocultural approach, since monitoring peers' dialogue and actions contributes to a better understanding of the underlying mechanisms. To this end, by zooming in the collaborative interactions, as the sociocultural approach suggests, the complex processes that reciprocally affect peers during computer-mediated collaborative learning in primary schools are revealed and understood.

To probe further, an analysis of the monitored interactions could be performed in a real-time context, allowing for the provision of appropriate feedback at a collaborative level. For instance, the balance between peers could be estimated based on the level of collaborative talk and the joint actions they exhibit, and when there is a significant divergence or increase in domination, warning messages could be displayed accordingly to facilitate convergence to mutual contribution to the joint task. Ongoing work is currently directed towards this.

REFERENCES

1. Light, P. and Littleton, C., *Getting IT Together*. In: Littleton, K. and Light, P. (Eds), Learning with Computers: Analysing Productive Interaction. London: Routledge, 1-9 (1999).
2. Sutherland, R., Designs for learning: ICT and knowledge in the classroom. *Computers and Educ.*, 43, **1-2**, 5-16 (2004).
3. Smeets, E., Does ICT contribute to powerful learning environments in primary education? *Computers and Educ.*, 44, **3**, 343-355 (2005).
4. Crook, C., *Computers and the Collaborative Experience of Learning*. London: Routledge (1994).
5. Dillenbourg, P., *Collaborative Learning Cognitive and Computational Approaches*. Oxford: Pergamon (1999).
6. Dillenbourg, P., Baker, M., Blaye, A. and O'Malley, C., *The Evolution of Research on Collaborative Learning*. In: Spada, E. and Reiman, P. (Eds), Learning in Humans and Machines: Towards an Interdisciplinary Learning Science. Oxford: Elsevier, 189-211 (1995).
7. Stahl, G., Group cognition in computer-assisted collaborative learning. *J. of Computer Assisted Leaning*, 21, 79-90 (2005).
8. Wegerif, R. and Dawes, L., *Computers, Talk and Learning*. In: Wegerif, R. and Scrimshaw, P. (Eds), Computers and Talk in the Primary Classroom. Clevedon: Multilingual Matters, 226-238 (1997).
9. Soller, A., Lesgold, A., Linton, F. and Goodman, B., What makes peer interaction effective? Modeling effective communication in an intelligent CSCL. *Proc. American Assoc. for Artificial Intelligence Fall Symp.*, Massachusetts, USA (1999).
10. Staarman, K.J., Face-to-face talk to support computer-mediated discussion in a primary school literacy practice. *Reading Literacy and Language*, 37, **2**, 73-80 (2003).
11. Mercer, N., Littleton, K. and Dawes, L., Computers and learning conversations. Paper presented at the *Learn IT Seminar*, Gothenburg, Sweden (2003).
12. Mercer, N., *Words and Minds: How We Use Language to Think Together*. London: Routledge (2000).
13. Rojas-Drummond, S. and Mercer, N., Scaffolding the development of effective collaboration and learning. *Inter. J. of Educational Research*, 39, **1-2**, 99-111 (2003).
14. Wegerif, R. and Mercer, N., Using computers to help coach exploratory talk across the curriculum. *Computers and Educ.*, 26, **1-3**, 51-60 (1996).
15. Glaser, G.B. and Strauss, L.A., *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine de Gruyter (1967).