Available online at www.sciencedirect.com

ScienceDirect

Procedia Social and Behavioral Sciences 2 (2010) 2610–2615

Procedia
Social and Behavioral Sciences

WCES-2010

The three T's of the structure of online collaborative activities

Donatella Persico[a] *, Francesca Pozzi[a]

[a]*Istituto Tecnologie Didattiche – CNR, Via De Marini 6, 16149 Genova, Italy*

Received October 21, 2009; revised December 30, 2009; accepted January 12, 2010

Abstract

This paper proposes to regard the structure of CSCL activities as an entity composed of the three independent dimensions: Time, Tasks and Teams. The paper analyses the collaborative processes activated by students during five different types of activities (Discussion, Peer Review, Case Studies, Role Play and Jigsaw). Based on real life data, the authors try to identify the relations between the three dimensions and the nature of the learning process.

Keywords: Computer supported collaborative learning; discussion; peer review; case studies; role play; jigsaw; structured activities.

1. Introduction

This study is rooted in the field of Computer Supported Collaborative Learning (CSCL) (The Cognition and Technology Group at Vanderbilt, 1991; Scardamalia & Bereiter, 1994; Dillenbourg, 1999; Paloff & Pratt, 1999; Hernández-Leo et al., 2006; Fischer et al., 2007), a research field inspired by the socio-constructivist learning principles: learning is an active rather than passive process where language plays a key role and new competence is built on the basis of previous knowledge. As a consequence, the learning environment should be learner-centred and the role of the teacher is that of a guide, a facilitator, almost a partner. According to Kanuka & Anderson (1999), "while not all instructional methods translate well to technology-mediated learning, most do - and some work even better online than in face-to-face learning environments".

The types of activities that can be proposed to students in CSCL contexts are very diversified, and may range from simple, unstructured discussions on specific topics, to highly structured tasks, with a common artifact to be collaboratively produced by students as an output of their activity. An example of a moderately structured type of activity is the Discussion, herein defined as an activity where no specific rules are imposed on students who are asked to carry out a group discussion finalized to the collaborative production of an artifact (e.g. a document, a concept map). On the other hand, highly structured activities, such as the Jigsaw (Aronson et al., 1978; Blocher, 2005), are those where the social structure of the groups and the way they are asked to interact internally and externally with the other groups are more strictly guided, in terms of aims, schedule, outputs, grouping, etc. The debate about whether instructional designers of online collaborative activities should, or should not, provide their

* Donatella Persico. Tel.: +30-10-6475313; fax: +30-10-6475300
E-mail address: persico@itd.cnr.it

1877-0428 © 2010 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.sbspro.2010.03.382

students with clear and detailed instructions about how to go about during CSCL processes, has been going on for some time now (Hewitt, 2005; Bell 2004, Liu & Tsai, 2008; Demetriadis et al., 2009; Dillenbourg & Jermann, 2007). Dillembourg (2002) started it by suggesting that scripting, i.e. providing a more-or-less rigid set of rules imposing a structure on students activities, risks to contradict the very spirit of the underpinning learning theory of socio-constructivism. However, practitioners know that the degree of self-regulation displayed by learners in CSCL varies a lot and that, roughly speaking, the less learners are able to control their own learning, the more they need somebody else to do it for them. Aim of this paper is to investigate whether this "rule of thumb" really applies by looking in depth at five types of activities frequently used in CSCL: the Jigsaw, the Peer Review, the Role Play, the Discussion and the Case Study. To do this, the structure of the activities is not regarded as a mono-dimensional entity, but is described in terms of three rather independent dimensions: Time, Tasks and Teams. By analyzing the collaborative processes activated by students during the various activities, the authors will try to identify the main pros and cons of imposing constraints on Time, Tasks and Teams in online collaborative learning activities.

2. Research context and method

The study has been carried in the context of a course on "Educational Technology", designed and run by the authors for trainee teachers. Aim of the course (herein called TD-SSIS course) was making students familiarize with the most important issues related to the introduction of ICT in schools (Delfino & Persico, 2007). The TD-SSIS course was run for two different Italian teacher training institutions (SSIS Liguria and SSIS Veneto) in the last six years. Although each year the course had its own specificities, in terms of learning objectives, contents, activities, schedule, etc., all of its editions had an online component based on a CSCL approach, where trainees were required to carry out collaborative activities under the guidance of tutors. During each edition of the course different kinds of online collaborative activities were proposed to students. Their structures also varied, but the most frequently adopted were: Discussion, Peer Review, Case Study, Role Play and Jigsaw. These different structures are described in the following in term of Task, Team, and Time, that is the three elements determining the level of structuredness of the activities themselves. In principle, these dimensions are rather independent, in that the same activity maybe highly structured in terms of time, because the tutor indicates deadlines for each subtask, but quite unstructured in terms of teams, if learners are free to choose the groups they want to work with, and of course the other way round. The task too may be defined very thoroughly or there may be various degrees of freedom to its interpretation, execution and accomplishment. The three together, however, may describe the structure in a rather complete manner. For this reason, in the following, the structure of the activities proposed to the students is described in terms of these dimensions.

D SCUSSION	***Level of structured ness***	***Description***
Task	low	Aim of the activities based on discussion is to critically analyse a problem, a topic or a subject. The key idea is to make sure learners reach a deep understanding of the subject, considering it from different points of view, taking into consideration the pros and cons of different alternatives as well as the opportunities and threats of any given situation. As a consequence, the role of the tutor is to facilitate the emerging of different ideas and points of view, fostering reflection and supporting in depth investigation of the subject. The production of an artefact can act as a catalyst of understanding and triggers message exchanges.
Teams	low	To this end, teams can be handled in a flexible way. They can be of different sizes, even of size that vary in time, and they can be formed by the learners themselves.
Time	low	Discussion usually needs to be ignited and should not go on forever, but there is no need to stick to the schedule too rigidly, unless there is an external constraint imposing the end of the activity by a given deadline.
P ER R VIEW	***Level of structured ness***	***Description***
T sk	high	The task basically consists of three phases. In the first phase individual students or teams produce an artef t, in the second another student or team reviews it and provides formative feedback on it, in the third phase the au ors of the artefact revise the artefact it according to the feedback received.
T ams	low	The task nature doesn't impose strict requirements on the team structure, provided they stay the same from he beginning to the end of the activity.
T ne	high	Since the task is usually carried out in a reciprocal way, the individuals (or teams) must work synchronou ly in order to swap the products of their work. This imposes quite a high level of structured ness in terms of tir e.
C SE S UDY	***Level of structured ness***	***Description***

Task	high	The task is highly structured by the case study method. The tutor must specify quite clearly what the students are supposed to do to carry out the case study. For example, the learners might be required to work out a solution for a complex problem and then compare it to an expert solution, trying to carry out a sort of self-assessment. Sometimes, case studies can effectively be carried out through a role play.
Teams	low	Teams for case study activities can be flexible. Trainees can choose who they would like to work with. Of course, letting the students form the teams will entail allowing them some time to do so and relying on their self-regulation in forming the partnerships. Often students tend to form homogeneous groups, while heterogeneous ones are actually preferable.
Time	low	Like in role play, there are no particular constraints on time, safe for external constraints. To allow for a reasonable in depth analysis, time should not be too short.
R LE PLAY	***Level of structured ness***	***Description***
Task	high	In activities based on role play, trainees usually have to take on a role (generally they can choose it from a pre-defined set, including all the possible ones). The role usually entails a "point of view", in that playing a part means trying to reason as if one was that character. Kanuka and Anderson (1999) claim that, in a debate, learners should be given roles that force them to take a stand that is contrary to their current belief system, so to understand others points of view.
Teams	high	The size of the teams mostly depend on the number of roles to be played, and the roles determine their internal structure.
Time	low	There are no particular constraints on time, safe for external constraints. Usually students play their role throughout the whole activity, except perhaps the conclusive session.
J :SAW	***Level of structured ness***	***Description***
T sk	mediu m	The task of a Jigsaw usually requires the tutor to identify a number of sub-topics or points of view for the ıbject to be learnt. Then the task is organized into two phases: during the first phase each team studies in detail one subtopic (or the whole subject form one point of view). During the second phase, new groups are formed consisting of one person for each of the previous teams. These new groups have to discuss and produce a shared document another kind of artefact, taking advantage of the competence developed by each member in the first phase.
T ams	high	The organization of teams is usually quite complex and requires the tutor to be quite directive about it. In t e first phase of the activity the students are split into as many groups as the sub-topics (or points of view) identifi d. In the second phase they are re-aggregated in new teams, in such a way that each group comprises at least one m nber for each of the previous groups.
T me	high	The organisation of the jigsaw groups requires respect for a rigid schedule: the groups of the second phase :an only be formed if those of the first phase have finished their task and are ready to act as experts in the second p| ıse. For this reason the Time dimension is highly structured in the jigsaw activities.

For the sake of this study, 2 particular editions of the course (TD-SSIS Liguria 2007 and TD-SSIS Liguria 2005) have been selected. As already mentioned, the 2 courses had the same general aims, but they were structured differently. More specifically, TD-SSIS Liguria 2007 envisaged three subsequent online collaborative activities: the first activity was based on a Jigsaw and lasted 2 weeks; during the second and third activities, lasting 3 weeks each, students were proposed respectively a Role Play and a Discussion. The CMC system used for carrying out the online activities was Moodle[2]. In TD-SSIS 2005, instead, the activities proposed included: a Peer Review (2 weeks), a Role Play (3 weeks) and a Case Study (3 weeks). In this case, the CMC system used for carrying out the online activities was Centrinity First Class[3]. In order to investigate the learning process resulting from the above mentioned activities, the interactions occurred within 5 groups of students (each performing one of the above mentioned activities) were analyzed and evaluated. The groups were selected because they all shared the same tutor.

Starting from the state of the art in the field (Henri, 1992; Hara et al., 2000; Rourke et al., 2001; Lally, 2002; Lipponen et al., 2003; Martinez et al., 2003; Daradoumis et al., 2004; ICALTS Kaleidoscope JEIRP[4]; Schrire, 2006, Strijbos et al., 2006; Weinberger & Fischer, 2006; Garrison ans Anderson, 2003; Pozzi et al, 2007), the authors proposed a model to evaluate CSCL processes encompassing four main dimensions, namely: the participative, social, cognitive and teaching dimensions (Persico et al., 2009). In order to bridge the gap between the theoretical framework and its practical applications, suitable indicators have been identified for each dimension, consisting of quantitative or qualitative variables that allow the analysis of each dimension according to specific objectives. These indicators express the actual manifestations of the four dimensions in a learning community. In particular, indicators of the participative dimension include the number of "active actions" by members of the learning community (in

[2] http://www.moodle.org
[3] http://www.centrinity.com/
[4] http://www.rhodes.aegean.gr/ltee/kaleidoscope-icalts/

terms of sent messages, uploaded documents, etc.), the number of "reactive actions" (e.g. reading messages, downloading documents, etc.), as well as the level of "continuity" in participation across time. Indicators of the social dimension include clues of "affection" (which is typically revealed by expressions of emotion or intimacy, humour or irony, presentations of personal anecdotes) and "group cohesion" (such as vocatives, expressions revealing group-self efficacy, use of inclusive pronouns to refer to the group, phatics, salutations). As far as the cognitive dimension is concerned, the model makes a distinction between clues of "individual" and "group knowledge building", by assuming that a collaborative activity in CSCL contexts typically requires a first stage entailing a personal ri-elaboration of contents and the expression of individual points of view, and a second stage devoted to discussion and negotiation to collaboratively construct shared meanings and common interpretations of reality. Moreover, according to the model, the cognitive dimension also encompasses "meta-reflection", to recognize the importance of students reflections on, and evaluations of, the learning process itself. Lastly, indicators of the teaching dimension include taking care of "organizational aspects", "discourse facilitation" and "direct instruction".

This approach has been used to analyze and evaluate all the messages exchanged during the five activities by the students of the selected groups. Data concerning the participative dimension were automatically obtained from server and system logs, while data concerning the social, the cognitive and the teaching dimensions were obtained through content analysis of exchanged messages in order to detect whether and to what extent the three dimensions could be traced[5]. The corpus of the analyzed messages was composed of a total of 794 messages.

3. Main results and Discussion

The data obtained from the analysis of the interactions among students can be looked at from different perspectives. In this exploratory study, we propose to use the model to identify differences in the way each activity fostered the indicators of each dimension. The idea is to explore to what extent the degree of structuredness of the different types of activity influences the quality of the learning process, and possibly to go into more detail by investigating whether some of the three Ts are more influential, with some respect, than others.

For example, Table 1 reports the mean number of sent messages per student (indicator of active participation) during the Discussion, the Peer Review, the Case Study, the Role Play and the Jigsaw. From the table, one may note that the Jigsaw, which is highly structured, produced the highest level of sent messages per week, and the Discussion, which has a low degree of structure, produced the second highest. According to these data, there is no apparent correlation between the three Ts of the structure of the activity and the level of participation on the side of the students.

Table 1 – Active participation (messages sent) by each activity type (source: TD-SSIS Liguria 2005 and TD-SSIS Liguria 2007)

Activity type	*Activity struct edness (Task, Teams, ime)*	*Mean number of essages sent per student*	*Standard viation*	*Mean per student/ per week*
Discussion (3 w eks)	Low, Low, Lo	11.04	5.98	3.68
Peer Review (2 eeks)	High, Low, Hi h	4.05	2.54	2.02
Case Study (3 v eks)	High, Low, L v	7.56	5.53	2.45
Role Play (3 we ks)	High, High, L w	8.68	5.16	2.89
Jigsaw (2 week	Medium, High High	8.23	3.64	4.11

On the same vein, when looking at the development of the social dimension across the activities (Table 2), one may note that while Task and Time do not affect Affection, it seems that the level of structuredness of Teams do, as the activities with low structured Teams (Discussion, Peer Review and Case Study) registered higher values of Affection, than those with highly structured Teams (Role Play and Jigsaw). As far as Cohesion is concerned, the nature of the Task seems to be determining, as in those activities with low or medium degree of Task structure (Discussion and Jigsaw) Cohesion registered higher values. From the data reported in this table, it seems that Time structure does not significantly influenced the social dimension.

[5] The unit of analysis chosen for the coding procedure was the "unit of meaning" (De Wever et al., 2006) and each unit could be assigned at maximum one indicator. The coding process was carried out by two independent coders, who – after a period of training - worked separately; the inter-rater reliability between the two was calculated on a sample of 20% of the total messages and resulted in a Holsti coefficient of 0,90 (percent agreement 0,84), which is usually considered a good result.

Table 2 – Indicators of the social dimension (source: TD-SSIS Liguria 2005 and TD-SSIS Liguria 2007)

Type of activity	*Activity structuredness (Task, Teams, Time)*	*S1 - Affection (mean value per student /per week)*	*S2 - Cohesion (mean values per student /per week)*
Discussion	Low, Low, Low	1,70	5,17
Peer review	High, Low, High	2,03	2,63
Case study	High, Low, Low	2,35	3,48
Role play	High, High, Low	1,00	3,25
Jigsaw	Medium, High, High	1,42	4,69

Similarly, one may look at the cognitive or the teaching dimensions across the activities and reflect on the impact each of the three Ts has on the various indicators. For example, looking at the data of the following table, one may note that an activity with a highly structured Task and Time but with low structured Teams (the Peer Review), seems to have a very positive influence on individual knowledge building, while when all the three Ts are highly or medium structured (as in the Jigsaw) it is the group knowledge building which seems to be fostered.

Table 3 – Indicators of the cognitive dimension

Type of activity	*Activity structuredness (Task, Teams, Time)*	*C1 – Individual Knowledge Building (mean values per student /per week)*	*C2 – Group Knowledge Building (mean values per student /per week)*	*C3 – Meta-reflection (mean values per student /per week*
Discussion	Low, Low, Low	1,86	2,59	0,46
Peer Review	High, Low, High	7,32	1,68	0,29
Case Study	High, Low, Low	2,29	2,48	0,56
Role Play	High, High, Low	1,13	2,25	0,10
Jigsaw	Medium, High, Hig	2,26	4,21	0,61

4. Conclusions

The main claim of this paper is that the structure of CSCL activities is not a continuum, going from unstructured activities, to those which are most structured and pre-defined, but a three dimensional space, where the axes are the structure of Task, Teams and Time. The results of this study should be confirmed by further statistical analysis, but they seem to indicate that there is not a direct association between structuredness (as a unique variable) and the frequency of the various indicators of our model, but rather, the relationship, if any, seems to be more complex. In most cases, it is the *lack* of structure of one of our Ts that seems to be associated to a higher rate of some of the indicators. For example, the participative dimension is higher when the task is quite unstructured, the social dimension components (cohesion and affection) are differently associated to low levels of structure of Task and Teams. In other cases, the key element to influence one indicator, seems to lay in the combination of different levels of structuredness, as in the case of individual knowledge building, which seems particularly promoted when Task and Time are highly structured and Teams are not.

To conclude, even if we agree with Dillenbourg (2004) that the kind of activity chosen by an instructional designer may "enhance the probability that productive interactions occur" but will never determine or guarantee the features of the learning process, we believe further research deserves to be carried out to understand which are the variables (besides students, of course) that influence the nature of the learning process. For this reason this study will be enriched with statistical measures to determine whether the results obtained so far can be considered statistically significant or not, and to further investigate the correlation between each T and the various indicators of the model.

5. References

Aronson, E., Blaney, N., Stephin, C., Sikes, J. & Snapp M. (1978). *The jigsaw classroom*. Beverly Hills, CA: Sage Publishing Company.

Aviv R., Erlich Z., Ravid G., Geva A. (2003). Network analysis of knowledge construction in asynchronous learning networks. *Journal of Asynchronous Learning Networks*, 7(3), 1-23.

Bell, P. (2004). Promoting students' argument construction and collaborative debate in the classroom. In M. C. Linn, E. A. Davis & P. Bell (Eds.), *Internet environments for science education*, (pp. 114-144), Mahwah, NJ: Erlbaum.

Blocher, J.M. (2005). Increasing learner interaction: using jigsaw online. *Educational Media International*, 42(3), 269-278.

Daradoumis, T., Martinez-Monés, A. & Xhafa, F. (2004). An integrated approach for analysing and assessing the performance of virtual learning groups. *Lecture notes in Computer Science*, 3198, 289-304.

Delfino, M. & Persico, D. (2007). Online or face-to-face? Experimenting different techniques in initial teacher training. *Journal of Computer Assisted Learning*, 23(5), 351–365.

Demetriadis, S. Dimitriadis, Y. & Fischer, F. (2009). Introduction to the SFC-2009 Workshop. In: *Proceedings of the workshop "Scripted vs. free collaboration: alternatives and paths for adaptable and flexible CS scripted collaboration"*, Rhodes, June 2009. Available online at: http://mlab.csd.auth.gr/cscl2009/SFC-files/SFC-2009-WorkshopProceedings.pdf

De Wever, B., Shellens, T., Valcke, M., & Van Keer H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers and Education*, 46, 6-28.

Dillenbourg, P.(2004). Split where interaction should happen- A model for designing CSCL scripts. In *Proceedings of the "Special Interest Meeting 2004 of EARLI SIG 6 and SIG 7"*, Tuebingen, 2004. Available online at: http://www.iwm-kmrc.de/workshops/SIM2004/pdf_files/Dillenbourg.pdf

Dillenbourg, P. (Ed.) (1999). *Collaborative Learning: Cognitive and Computational Approaches*. Pergamon Press.

Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In: Kirschner P. A. (Ed.), *Three worlds of CSCL. Can we support CSCL*, (pp. 61-91), Heerlen, NL: Open Universiteit Nederland.

Dillenbourg, P. & Jermann, P. (2007). Designing interactive scripts. In F. Fischer, I. Kollar, H. Mandl, and J. Haake, (Eds.) *Scripting computer-supported collaborative learning: Cognitive, computational and educational perspectives*, (pp. 276-301), New York: Springer.

Fischer, F., Kollar, I., Mandl, H., & Haake, J.M. (Eds.) (2007). *Scripting computer-supported collaborative learning – cognitive, computational, and educational perspectives*. New York: Springer.

Garrison R. & Anderson T. (2003). *E-learning in the 21st century. A framework for research and practice*. London and New York: Routledge Falmer.

Hara N., Bonk C. J. & Angeli C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science*, 28, 115-152.

Henri, F. (1992). Computer conferencing and content analysis. In A. R. Kaye (Ed), *Collaborative Learning Through Computer Conferencing*, (pp. 115—136), The Najaden Papers, New York: Springer.

Hernández-Leo, D., Villasclaras-Fernández, E. D., Asensio-Pérez, J. I, Dimitriadis ,Y., Jorrín-Abellán, I. M., Ruiz-Requies, I. & Rubia-Avi, B. (2006). COLLAGE: A collaborative Learning Design editor based on patterns. *Educational Technology & Society*, 9 (1), 58-71.

Hewitt, J. (2005). Toward an understanding of how threads die in asynchronous computer conferences. *The Journal of the Learning Sciences*, 7(4), 567-589.

Kanuka, H. & Anderson, T. (1999), Using Constructivism in Technology-Mediated Learning: Constructing Order out of the Chaos in the Literature. *Radical Pedagogy*. 1(2).

Lally, V. (Ed) (2002). Elaborating collaborative interactions in networked learning: a multi-method approach. In: *Proceedings of the Networked Learning Conference*, March 2002, University of Sheffield.

Lipponen, L., Rahikainen, M., Lallimo, J. & Hakkarainen, K. (2003). Patterns of participation and discourse in elementary students' computer-supported collaborative learning. *Learning and Instruction*, 13, 487-509.

Liu, C., & Tsai, C. (2008). An analysis of peer interaction patterns as discoursed by on-line small group problem-solving activity. *Computers & Education*, 50, 627–639.

Martinez, A., Dimitriadis, Y., Rubia, B., Gomez, E. & De La Fuente, P. (2003). Combining qualitative evaluation and social network analysis for the study of classroom social interactions. *Computers & Education*, 41(4), 353-368.

Palloff, R. M. & Pratt, K.(1999). *Building learning communities in cyberspace*, San Francisco: Jossey-Bass Publishers.

Persico, D., Pozzi, F. & Sarti, L. (2009). A model for monitoring and evaluating CSCL. In: Juan, A.A., Daradoumis, T., Xhafa, F., Caballe, S., Faulin, J. (Eds.) Monitoring *and Assessment in Online Collaborative Environments: Emergent Computational Technologies for E-learning Support*. IGI Global.

Pozzi, F., Manca, S., Persico, D. & Sarti, L. (2007). A general framework for tracking and analyzing learning processes in CSCL environments. *Innovations in Education and Teaching International*. 44(2), 169-180.

Rourke, L., Anderson, T., Garrison, R. & Archer, W. (2001). Methodological Issues in the Content Analysis of Computer Conference Transcripts. *International Journal of Artificial Intelligence in Education*, 12, 8-22.

Scardamalia, M. & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences*, 3(3), 265-283.

Schrire, S. (2006). Knowledge building in asynchronous discussion groups: Going beyond quantitative analysis. *Computers & Education*, 46, 49-70.

Strijbos, J. W., Martens, R. L., Prins, F. J. & Jochems, W. M. G. (2006). Content analysis: What are they talking about? *Computers & Education*, 46, 29-48.

The Cognition and Technology Group at Vanderbilt (1991). Some thoughts about constructivism and instructional design. *Educational Technology*, 31(10), 16-18.

Weinberger, A., Fischer, F. (2006). A framework to analyse argumentative knowledge construction in computer-supported collaborative learning. *Computers & Education*, 46, 71-95.