

Mixed-Method Validation of Pedagogical Concepts for an Intercultural Online Learning Environment: A Case Study

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ABSTRACT

The rise of social software poses the challenges to the design and evaluation of a pedagogically sound online learning environment (OLE). Our OLE addresses these challenges by the integration of three pedagogical concepts – cross-cultural collaboration, self-directed learning and social networking – with the aim to advance participants’ competencies and by mixed-method approaches to evaluating the complex situations. A validation trial involving four European countries was conducted. Groups of students co-created a questionnaire, which was assessed to provide an indicator of task performance. Multi-source (surveys, blogs, emails, diaries, chats, videoconference, and interviews) and multi-perspective data (facilitators, students, researchers) were studied with social network analysis, content analysis and conversation analysis. Several *a posteriori* research questions are addressed.

Categories and Subject Descriptors

K.3.1 [Computer Uses in Education]: *Collaborative Learning*

General Terms

Measurement, Performance, Design, Theory

Keywords

Online learning environment, social network analysis, cross-cultural, self-directed learning, competencies

1. INTRODUCTION

Today's social software is analogous to groupware appeared in 1990s with the former being more versatile and light-weight and being able to support a wider range of group activities more dynamically than the latter. Types of software application enabling communication, interaction and collaboration transcendent of time and space are ever expanding, e.g., blog, wiki, photo-sharing, social book-marking, IP telephony, videoconference, etc. The soaring popularity of social software [2] concomitantly poses two major challenges to researchers and practitioners: Firstly, which theoretical frameworks can inform

the design of online learning environments (OLEs) to exploit these emerging technologies? Secondly, which evaluation methodologies should be adopted as well as adapted to validate these OLEs and assess their impacts?

Our project, iCamp (<http://www.icamp-project.net>), aims to tackle these challenges. It is pedagogy- and validation-driven with the overarching goal of identifying improvement suggestions to refine pedagogical models and technological requirements for successful online cross-cultural collaborative learning. Pedagogically we ground in the social-constructivist theories. Technologically we build upon a selected set of prevailing technology-enhanced learning tools by rendering them interoperable. Our OLE exemplifies an intercultural computer-supported collaborative learning (CSCL) empowered by extensive uses of social software. Its validation is realized through three trials, which have different foci and scales and involve different Higher Education Institutions (HEIs) in Europe. The research methodology embraced is akin to the design-based research, which, with the deployment of mixed methods, aims to meet dual goals of refining locally educational practice or intervention and developing more globally usable knowledge for the field. Whereas the first validation trial (Trial-1) is mainly exploratory, the second and third validation trial will be formative and summative, respectively. The design of our OLE is ameliorated according to the outcomes of the validation trials.

In this paper we initially present our theoretical framework, which is built upon three pedagogical pillars (Section 2). Next, we describe the structure and activities of the first trial (Section 3), and then specific evaluation instruments we have developed and deployed for data capture and analysis (Section 4). Results are presented next (Section 5). Finally, we discuss our findings with respect to the three pedagogical concepts and draw implications for the design and evaluation of future OLEs (Section 6).

2. THEORETICAL FRAMEWORK

2.1 Design-based Research

In the context of our project, the intervention is *not* the traditional, formal approach of experimental psychology where neat manipulation of variables is required. Instead, the intervention is the access to networked communications and interactions as well as the support enabling the effective use of such an access. We espouse the design-based research (DbR) approach that attempts to bridge educational theory, design and practice [7]. The DbR uses mixed methods [8] by blending qualitative approaches with quantitative ones to analyse outcomes of an intervention (i.e. provision of the OLE, integrating different roles, methods and

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tools) and to refine the intervention. In particular, the DbR typically triangulates multi-perspective data from different sources to link intended and unintended outcomes to processes of enactment. This triangulation can not only enhance the validity and reliability of empirical findings but also deepen insights into phenomena of interest. Each of the three validations trials, as a kind of sustained intervention being embedded in a three-month regular curriculum in an HEI, are messy settings prone to complications. A complex intervention as such can involve tens of designers, theorists, evaluators, facilitators and students who aim to experience or improve the innovative practice. In these situations, it is extremely difficult to decipher or disambiguate causality; influencing factors are so intertwined that it is impractical to isolate or study them. Hence, mixed-method evaluations and repetition of analyses across cycles of enactment are indispensable.

2.2 Three Pedagogical Pillars

We identify three pedagogical concepts highly relevant to the development of our OLE, viz. cross-cultural collaboration (CCC), self-directed learning (SDL) and social networking (SNW), each of which entails specific analytic and empirical evaluation approaches.

2.2.1 Cross-Cultural Collaboration

CCC was the focus of Trial-1, though SDL and SNW were investigated as well. A model for evaluating CCC has been developed by Convertino and his colleagues [4]. It comprises three components (cf. the information processing theory): Team *input* consists of cultural composition and collaboration medium; Team *process* consists of common grounds, cognitive consensus, and awareness; Team *output* consists of cognitive consensus achieved, perceived satisfaction, and observed/ perceived performance. This model is similar to Setlock et al.'s [19] framework. We derive from these earlier studies our evaluation scheme, placing emphasis on two aspects of the collaborative process: quality of interaction and task performance (Table 1).

Table 1. An evaluation scheme for cross-cultural collaboration

Aspects	Rationale and Metrics	Data Analysis
Quality of Interaction	It comprises three factors: <i>Social</i> - How well individual group members are collaborating in terms of mutual respect, responsiveness, politeness, friendliness, etc. <i>Cognitive</i> - How well the group performs the task in terms of mutual stimulation, ease of drawing consensus; effective use of time; <i>Affective</i> - How satisfied or frustrated the group members feel during the task.	- Content analysis of blogs and emails - Conversation analysis of online chats and video-conference - Questionnaire for measuring cross-cultural interaction
	The extent to which the jointly created artefact meets the quality criteria such as scope coverage, innovativeness, presentation, etc.	- Review of the artefact by experts - Peer assessment

2.2.2 Self-directed Learning (SDL)

The notion of SDL is defined by Knowles [14] in his seminal book and expanded by subsequent research. SDL denotes that the

learner initiates the learning, makes the decisions about what kinds of learning experiences are expected to occur, how and when. A self-directed study can involve different activities and resources, ranging from individual self-guided reading/writing to participation in an online collaborative learning group with enabling technologies. SDL implies the change of teaching role from being an instructor to a facilitator, which can effectively be realized by dialogue with learners, securing resources, evaluating outcomes, and promoting critical thinking [13]. While we will look into how students make use of learning contracts (NB: to be implemented in the second trial) and self-assess their SDL competencies, in the current trial we promoted SDL (Section 3.2) and explored how teachers and students perceived their respective roles. SDL competence is to understand the differences between teacher-directed and self-directed learning, to work collaboratively with others, and to select strategies skilfully and with initiative.

2.2.3 Social Networking

A group is essentially a social network that provides channels for information exchange among its members. The development of online social networks for information sharing is conceptualized as a four-tier inverted triangle (Figure 1). The inversion denotes the expanding scope of resources *for* and impacts *of* the activities in the corresponding tiers. The foundational first tier consists of four basic building blocks: Membership or group composition is a critical component as it influences the motivation of individual learners, whose needs (cognitive, social and emotional) determine how they behave in a group. These needs should be integrated and fulfilled through different activities enabled by the usable and useful tools selected. Equally important is to establish emotional bonds among members. Grounded in these building blocks, social networks can thus be meshed, which further facilitate communication and acquisition of three categories of key competencies [17]: use linguistic and technological tools interactively; interact in heterogeneous groups; act autonomously.

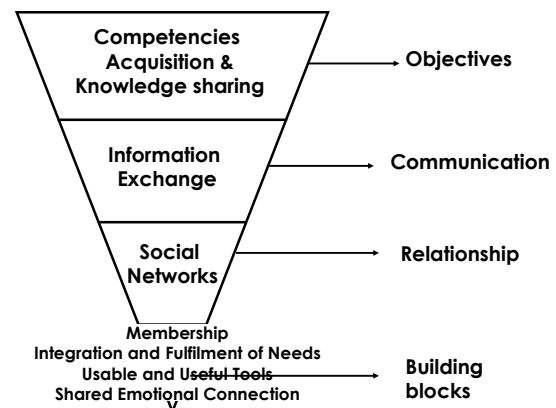


Figure 1. A framework of an online learning community (adapted from [12])

Social Network Analysis (SNA) [20] is well suited for the study of participatory aspects of learning under a situated perspective, as it places social relationships at the centre of the study, while providing both individual as well as group-level perspectives.

3. TRIAL STRUCTURE AND ACTIVITIES

Four academic institutions (or trial sites) in Europe, including Turkey, Poland, Estonia and Lithuania, participated in the first validation trial (Trial-1) conducted between Oct. 2006 and Feb 2007. Four types of key actors were involved:

- *Facilitators*: four faculty members, who were responsible to teach a course on research methods at the respective institutions, scaffolded their students to accomplish the given collaborative task of the trial;
- *Site Coordinators*: academic staff of the respective institutions, who were well-informed about pedagogical and technical requirements of the trial, provided constant support to the facilitators.
- *Students*: 36 undergraduates and postgraduates majored in social sciences or software engineering.
- *Research team*: coordinating and monitoring the progress of the trial, negotiating strategies and resolutions with other actors to deal with emerging needs and problems, and providing technical and pedagogical support to them.

3.1 Pre-Trial Preparation Phase

To ensure effective implementation of Trial-1, it was critical that the facilitators could develop their collaborative relationship by negotiating their knowledge and views on the related aspects at the possible earliest time. This process of social grounding [3] is deemed indispensable. Six months prior to the official launch of the trial, the four facilitators, who had hardly known each other beforehand, started to collaborate; several videoconferences have been held to identify the scope of collaboration, teaching/guidance approaches, group formation strategies, scheduling, etc. Apart from online discussion, the facilitators were provided a Web-based communication platform to exchange ideas and documents offline. Three key conditions for effective collaborative learning have been identified: *group composition*, *task features*, and *communication media* [5]. In our pre-trial preparation phase, we addressed these issues.

To facilitate social grounding among student participants and group formation, two procedures were involved: First, a videoconference linking the four trial sites was held; each participant (facilitators and students) took turn to make a brief online self-introduction. Second, each student was required to set up a personal blog to introduce themselves, thereby enabling the students to identify potential collaborative partners. To maximize cultural heterogeneity, some constraints were imposed that each group should consist of members originating from the four different trial sites and that not more than two from the same site should be included in a group. Otherwise, the students were free to join any group. Presumably such a self-regulated process could heighten the students' motivation to work with the partners of whom they had good impression. This strategy proved workable as eight groups with 4 or 5 members were formed. Each facilitator then supervised two groups. Apart from culture, the groups had interesting mix of gender, prior knowledge, English language competence, and IT skills. Such heterogeneity is considered desirable for triggering stimulating interactions among group members, but within the boundaries of mutual interest and intelligibility [6].

The collaborative task to be accomplished was the development of a questionnaire (i.e. artefact) with reference to two key concepts "cross-cultural comparisons" and "e-learning". The task

was selected based on several considerations: (i) Developing questionnaire is an integral part of a course on research methods that are commonly offered in the four sites; (ii) While heuristics for questionnaire developments are available, there is much room for planning and negotiation as questions can be formulated in various ways; (iii) The two key concepts are of high relevance to the online learning environment in which the students are embedded, thereby enabling them to reflect on their own situation. Given the heterogeneous backgrounds of the students and the objective of promoting self-directed learning, the students were given the leeway to specify the exact scope and theme of their questionnaire.

Collaboration may fail if communication media and tools deployed are inadequate, irrespective of whichever group composition and task features. There exist an abundance of multimedia tools supporting online collaboration and communication. To avoid overwhelming the participants, a subset of such tools was selected for Trial-1 primarily based on their accessibility and ease of learning. Blog, email and collaborative writing tool are deployed for asynchronous work whereas instant messages and videoconference systems are used for synchronous work. Pre-trial training was delivered to ensure that the facilitators and students, who had not worked with particular instances of tools prior to the trials, would feel confident and comfortable to use them.

3.2 In-Trial Implementation Phase

The collaborative task was marked by four milestones (M): *M1* - Identification of the theme of the questionnaire; *M2* - Drafting the questionnaire; *M3* - Refining the questionnaire; *M4* - Evaluation of the questionnaires. The groups supposedly worked in a self-directed manner. However, when needs arose, they could seek advice from their local facilitators, whom they met face-to-face on a regular basis, and from their remote (group) facilitator, whom they contacted via online communication tools. In fact, to foster SDL competencies in the students, the facilitators tended to practise non-interference in the groups' activities, but they monitored the group's progress and provided solicited help. In this phase, the facilitators and local site coordinators held videoconferences on a demand basis to share their observations about the progress of individual groups and to address emerging issues. Besides, they actively used the Web-based communication platform to exchange ideas.

3.3 Post-Trial Reflection Phase

The main objectives of this phase are to assess impacts of the trial on the actors involved, to reflect on lessons learnt, and to draw implications for the subsequent trials, especially inputs for technical requirements, trial organization and evaluation approaches. Semi-structured online interviews with the students from selected groups were conducted. There was also a face-to-face focus group session involving the facilitators and the research team. Besides, the questionnaires created by the student groups were assessed.

4. EVALUATION INSTRUMENTS

The complexity of our OLE entails mixed-method evaluations of multi-source and multi-perspective data. For Trial-1 we developed and deployed different evaluation instruments.

4.1 Surveys

To evaluate a learning environment, survey is one of the most popular evaluation instruments. In Trial-1, we administered two different online surveys to the students at the beginning and at the end of the in-trial period. The goal of the first survey was to collect data about the students' motivations, needs and expectations, self-perceived English proficiency and IT skills, previous experiences about online learning and tool uses, etc. The second survey aimed to collect the students' opinions, thereby enabling us to check whether the students' motivations had been changed and whether their needs and expectations had been met after participating in the trial. Another online survey, which was similar to the students' first survey in terms of the structure and goal, was administered to the facilitators at the beginning of the trial as well.

4.2 Communication Diaries

To monitor the process of online collaborative learning, it is essential to select some high-level variables (or indicators) that can represent states of collaboration among users of a learning community. It is challenging for evaluators to identify, capture and store such indicators. In our OLE, the students could basically use different communication tools, and it was extremely difficult, if not impossible, to get all the log data from these tools. To deal with the constraint, we developed an instrument known as "Communication Diary". Such a diary allowed the students and evaluators to keep track of the communications with their facilitators as well as peers. However, the students could decide not to use the Diary, though they were much encouraged to do so. The Diary was constructed on a weekly basis. There were essentially four working weeks in Trial-1 (i.e. excluding the post-trial reflection phase). The Diary was divided into four parts with each of them containing several question blocks. Each block recorded the communication that the students had with one partner (either a student or a facilitator) and consisted of 5 items, which are described as follows:

- (i) To specify with whom this student communicated.
- (ii) To specify if this student was the communication sender or receiver or both. A student was considered as a sender of a communication if he/she was the one who initiated that communication.
- (iii) To specify the frequency of the communication, i.e., the student should indicate how often he/she communicated with his/her partner. There were 3 levels: low, medium, or high.
- (iv) To rank the purpose of the communication. If the student had several purposes (e.g. he/she communicated several times with the same partner), the most important purpose should be ranked first.
- (v) To rank the modalities the student used for his/her communication(s). If he/she used different modalities to communicate, the most often-used modality should be ranked first.

Although the design of the Communication Diary was simple, it served as a useful instrument for researchers to construct the students' interactions and communications, thereby enabling the application of SNA or similar approach to construct the social structure and social relationships among the participants.

4.2 Other Instruments

Different tools were accessible to the students to support synchronous and asynchronous communications. The students were provided blogs (i.e. wordpress) and encouraged to use them to exchange ideas, but they could also use email. Besides, real-time discussion was enabled by IP telephony (e.g. Skype), videoconference (e.g. Flashmeeting) or instant messaging (e.g. MSN). The groups were also instructed to use a Web-based shared workplace - Google Docs & Spreadsheets - to create, modify and store their questionnaire. By analysing the contents captured by these tools, we might be able to know how the group collaboratively resolved their tasks.

Two student groups - Group2 and Group6 - were selected as *target* groups. They were observed to be relatively more active during the group formation phase (pre-trial phase) and during the first week of the trial. The selection was also based on the consent of the respective facilitators and on the willingness of the group members. The students of the two target groups were required to share their emails with us and to grant us the access right to view the progressive versions of their questionnaire shared in Google Docs & Spreadsheets. We also interviewed some students of the target groups and the facilitators in the post-trial reflection phase to review the process and outcome of the trial.

Furthermore, the students' task performance was measured in terms of the extent to which their questionnaire could meet certain quality criteria. The four facilitators jointly developed a grading scheme: The questionnaire was rated along three dimensions – the theme (e.g. relevance), design (e.g. accuracy) and implementation (e.g. layout) – with a five-point Likert scale. Using this scheme, each facilitator had to grade the questionnaires of all the eight groups (i.e. expert review) and each student had to grade all the questionnaires except the one of his or her own group (i.e. peer review). Besides, each student was required to evaluate the contribution of his/her team mates to the group work with respect to several aspects: communication, design of the questionnaire, and use of tools.

5 RESULTS

5.1 Social Networking

In view of the limited space, in this section we focus on the results of analyzing the activities of Group2, though results of Group6 are also presented to illustrate the commonalities and contrasts. Group2 consisted of 5 students who were designated as *g2.st1*, *g2.st2*, *g2.st3*, *g2.st4*, and *g2.st5*. The facilitator of this group was from Lithuania and designated as *fa3*. The four students of Group6 were similarly designated as *g6.st1*, *g6.st2*, *g6.st3* and *g6.st4* and its facilitator was from Turkey and designated as *fa2*. The term *participant* refers to a student, a facilitator or a member of the research team. A group should spend the first week to get to know each other and to define the theme for their questionnaire. The second (week2) and the third week (week3) should be dedicated to the development of the questionnaire and the fourth week (week4) should be used for the questionnaire revision. In fact, Group2, like some other groups, extended their work to the fifth and sixth weeks to finalize their questionnaire.

We applied the SNA approach to evaluate the social structures as well as communication and interaction patterns of the student

groups. Figure 2 and Figure 3 display the sociograms representing the social structure of group communications of Group2 and Group6 in the first four consecutive weeks of the trial, respectively. In the sociograms, nodes represent participants and lines represent the communication between them. Node shapes represent different types of users. In this case, circles represent students, diamonds represent facilitators, and rectangles represent

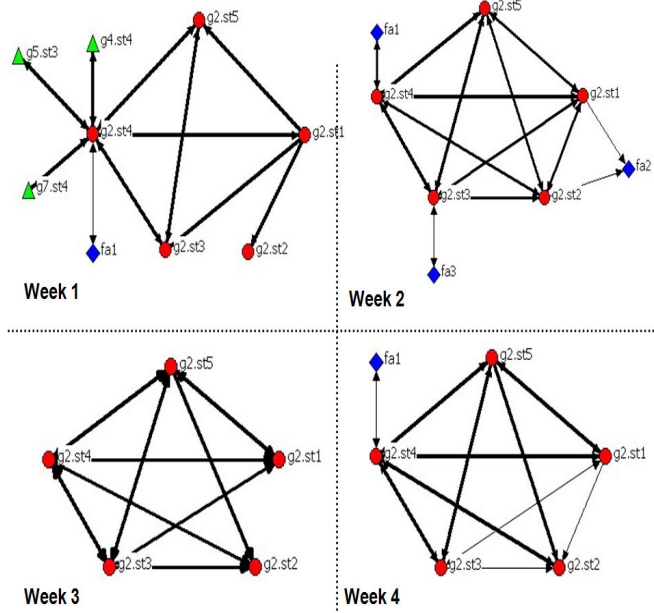


Figure 2. Sociograms of Group2 over 4 weeks of collaboration.

To identify the network sub-structures, i.e. the fully connected students, cliques are detected. A clique is defined as a maximal complete sub-graph [20], i.e., it contains a subset of participants, with all of them being adjacent to each other. For Group2, a clique was found in every week (see Figure 2). In other words, this group's members worked quite closely with each other. The network centrality in week 1 was not high (64% for both *Outdegree* and *Indegree* centralisation). It implied that none of the participants really played the central role in the social network of Group2 during this very first week. The network centralisation from week 2, 3 and 4 also confirms the “distributed nature” of Group2 (Table 2). No one played the central role in the group knowledge distribution and construction. Similar results were found in Group6 (Figure 3). This somewhat aligned with our expectation as one of the goals of the project was to facilitate peer communications. As the facilitator of Group2 adopted the non-intervention strategy, she was not expected to play a central role.

Table 2. Group2 network centralisation

	Week 2	Week 3	Week 4
Outdegree	35.374%	47.917%	48.000%
Indegree	35.374%	27.083%	48.000%

In week 2, Group2 started to work on the questionnaire theme and tried to find out the methodology, it seemed that this group got a bit lost and many members of the group contacted their local facilitators (*fa1*, *fa2*, *fa3*). However, in week 3, the group worked

the research team members. Line size represents the tie strength, and the arrows represent the directions of communications. Quite surprisingly, in the first week, none of the group members of Group2 contacted the group (remote) facilitator. The student *g2.st4* was the only one who contacted his local Polish facilitator (*fa1*) and other Polish students from other groups (*g4.st4*, *g5.st3*, *g7.st4*) to get more information about the trial.

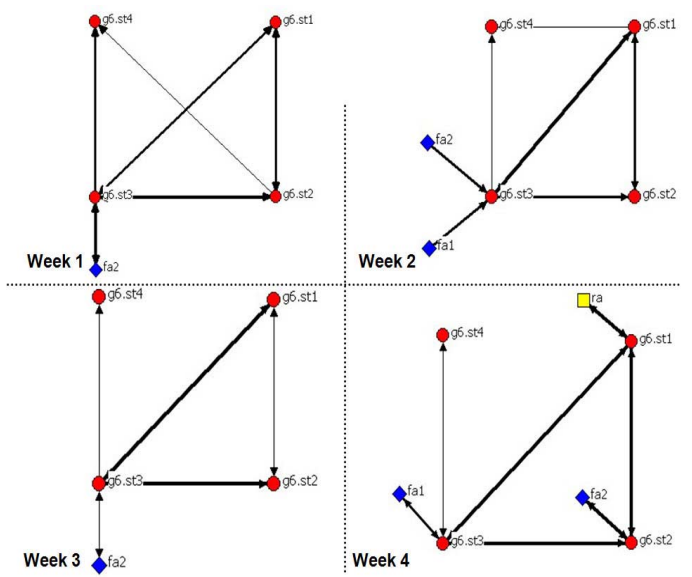


Figure 3. Sociograms of Group6 over 4 weeks of collaboration

quite confidently. They interacted with one another without contacting any facilitator. These interaction patterns were shown clearly in Figure 2. In the last week, only *g2.st4* contacted the local facilitator (*fa1*). Similarly, Group6 worked quite autonomously without any explicit intervention from either the local or group facilitator (Figure 3). As *g6.st4* had a full time job, she contributed modestly to the group activities. She just contacted *g6.st3* to keep informed about the group's progress.

5.2 Content Analysis of Blogs and Emails

For content analysis, we have adapted the framework and analytical model proposed by France Henri [11], which could provide a useful conceptual lens for understanding different dimensions of the learning process in an online collaborative environment [16]. Indeed, Henri's model has been adopted as well as adapted by a number of researchers for analysing computer-mediated communications (CMC) [e.g. 9, 10, 16, 22]. Henri applied her original model to asynchronous text-based CMC that allow learners to reflect deeply on the issue of interest. However, the scoping of Henri's model is disputable. While some researchers [10] employed Henri's model for analysing synchronous videoconference messages, others criticise that it is not appropriate for an online debate as it cannot reflect a holistic view of such an event [9]. We tend to endorse the contention that Henri's model is more suited for asynchronous than synchronous CMC, because generally the former can better support in-depth cognitive processes than the latter.

Specifically, we modified Henri's model by merging the participative and social dimension into "participatory activity" with four values: *coordination* (e.g. negotiating a meeting date), *technical* (e.g. resolving issues about tool uses), *social* (e.g. sharing personal problems), and *task* (e.g. discussing the design of the questionnaire). We applied it to analyse the contents extracted from blogs and emails to identify the communication and learning patterns of the target groups.

Each student group was required to set up a "group blog" that serves as a kind of online forum. However, Group2 seemed not interested in this communication instrument. During the whole trial period, there were only 5 entries in this group's blog. However, for Group6, the blog activities were much higher. There were 45 blog entries, in which 25% of blog units corresponded to coordination, 17% related to task, 14% were social and the rest were technical.

Group2 used emails as the main communication instrument. These emails were segmented into "units of meaning" (or thematic units) with each of them representing a single idea [11]. Each unit was assigned sequentially and chronologically a unique identifier and was coded according to the aforementioned coding scheme. Figure 4 displays the percentage of the emails with respect to the categories of "participatory activity".

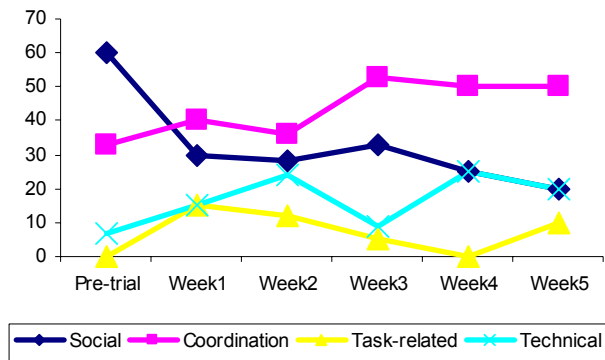


Figure 4. Distribution of Group2 emails into 4 activity types

The categories of the emails could partially reflect the working pattern of the group. For instance, in the pre-trial phase, the percentage of social messages was very high because during this phase, the students were socializing to form groups. In week 1, they began to talk about their assigned task, thus the number of task-related messages increased. Generally speaking, the low percentage of task-related messages was attributed to the fact that the group did not rely on emails to discuss or resolve their task. Asynchronous tools were used by Group2 as a means for social chat and for organising synchronous meetings in which they collaboratively constructed their questionnaire. Similarly, in Group6, the percentage of task-related email messages was also very low (5%) while the average percentage of coordination message was very high (56%).

Figure 5 shows the connectivity between units of meaning extracted from the emails exchanged by Group2 in the trial. In week 1 the units were either independent statements (i.e. disjoint nodes) or loosely linked (e.g. two nodes in a chain). However, in week 2 and week 3 a very high number of connected messages could be observed, especially a very long chain of units in week

2, which were actually related to how Group2 arranged their first real-time meeting using Microsoft MSN and shared some task-related ideas. In contrast, the number of connected messages exchanged by Group6 was quite low. Most of the messages were independent statements.

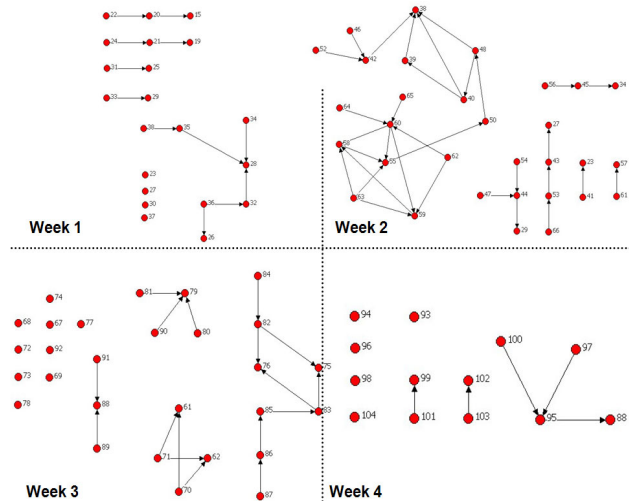


Figure 5. The social structure of Group2 communication

5.3 Instant Chats

Group2 used MSN chat as the main medium for the collaborative construction of the questionnaire. Analyzing the chat log can somehow reveal the quality of interaction, which manifests along the social, cognitive and affective dimension (Table 1). Cognitively, different phases of problem-solving could be identified, including brainstorming, drawing consensus, clarifying ideas, and compiling contributions. The log excerpt below illustrates how they brainstormed about the number of questions in the questionnaire:

g2.st5: there has to be at least 20
g2.st3: 20 questions?
g2.st1: so I think 20 questions are not enough, at least 35 or may be 40 questions

If they could not reach a consensus, they tended to postpone the final decision so each group member could have more time to review the ideas proposed by the other members. It can also be seen as a strategy to use the online time effectively. The students tended to show mutual respect, be polite and friendly – the competence of interacting in a heterogeneous group.

g2.st5: I have an idea -everyone makes up questions for those three parts - on their own - we post them on the blog by a certain time (2-3-4 days?) and then we meet to discuss it. What do you think?

g2.st1: dear friends I think we can not determine something in this way, because there are some nearly same but not exactly opinions and suggestions, so can we do this on your own and then mail to everyone, about how it was agree or disagree and we can combine 4 questionnaires together and make a new one

This synchronous communication instrument was also used for social chat. Although the goal of their meeting was to discuss the

task, the conversations were occasionally distracted because some members addressed irrelevant topics. Besides, we could tell how they were satisfied with their work

g2.st2 says: so we are a perfect group...

...

g2.st5 says: We're doing quite good, too, I think

...

g2.st4 says: We are the best, but not perfect

g2.st4 says: You have done also a masterpiece

Note that Group2 tended to use blogs grudgingly:

g2.st1: we all prepare our questionnaire according to our decision then mail to everyone as soon as possible

g2.st5: yes, but don't send it via e-mail - lets use blog- because we are a focus [target] group - they wanted us to use blog

As mentioned earlier, Henri's content analysis scheme is deemed inadequate for analysing synchronous CMC messages. Alternatively, we adopted Stahl's [21] conversation analysis framework, which allows us to derive from the logs a holistic view of the quality of interactions enabled by MSN chat. Accordingly, Group2 applied the *exploratory inquiry* method; the turns were more or less equally shared among the members when the group collectively investigated the problem and constructed the group artefact.

Analysis of multi-source data captured by different instruments enabled us to know the problem-solving strategies employed by Group2. This group did not use Flashmeeting because some of them lacked a webcam or microphone, some of them did not get the right instruction, and some were shy of speaking English. Hence, they resorted to text-based "traditional" communication instruments – emails and MSN chats. They only used blog and Google Docs & Spreadsheets because they intended to comply with the given instruction but they did not see the benefit of using these tools. In fact, Group2 adopted a mixed approach of cooperation and collaboration. After the group had agreed on the skeleton of the questionnaire, each member then created his or her own version offline and then merged all the versions through online discussions.

5.4 Videoconference

Synchronous communications in Group6 were mediated through Flashmeeting (FM; <http://flashmeeting.open.ac.uk/>), a lightweight videoconference tool. Two FMs took place in week3 and week4. The recordings were transcribed and analysed. The following discussion addressed the second FM (week4), which was more interesting when the group had already made some progress in their task and the members had known each other for some time. In contrast with their communications in blogs and emails, which were primarily for coordination and social purposes, those in FM were highly task-oriented with less than 5% of the time on non-task related issues such as occasional connectivity breakdowns.

Similarly (cf. Section 5.3), we applied Stahl's [21] framework to analyse FM recordings. The verbal protocols exhibited both *exploratory inquiry* and *expository narrative*. The cooperation strategy adopted by Group6 was "*divide-and-conquer*", with each member being responsible to draft one or two sections of the questionnaire. The group then gathered to address the strengths and weaknesses of individual sections. A member was involved in expository narrative when she was elaborating on the section she had created:

g6.st3: So in this section, I want to see what the students have an attitude for social learning and e-learning. ... So I created here 10 questions. What I created is Likert scale. ... I don't know. Maybe these questions are too much we can move something out and leave them out. ... But I don't know. What do you think about open questions? ...

When the other members responded with comments and suggestions, they were then engaged in exploratory inquiry. The following excerpt illustrates how the group addressed the issue of close-end versus open-end question by clarifying some misunderstanding:

g6.st3: Okay, so you say that open-ended answers give more freedom. So we have to wonder if open questions in this part are better or not. Or leave these questions I have created and add some open questions? ...

g6.st1: I am not sure whether you could understand me or not. I said open questions are equivalent to close questions. ... open-ended questions need more judge. Close-ended questions are easy to analyse. ... Is it okay or do you still have problem to understand me?

g6.st1, *g6.st2* and *g6.st3* were cognitively engaged in discussing the questions. Socially they tended to be cautious and avoided imposing their views on the others. For instance, oftentimes after expressing her view *g6.st3* added the remark: "... *That's my opinion... I don't know. . What do you think?*" Besides, they demonstrated three negotiation strategies to get their ideas accepted, namely, citing the authoritative (e.g. "*My facilitator said ...*"), repeating the opinion (e.g. "*As I said before ...*") and inviting an ally (e.g. "*I think we should take out g6.st2's question #7. g6.st1, what do you think?*"). Affectively, there were instances of frustration expressed by *g6.st2* when her proposed questions were criticized. She thus withdrew from the discussion (i.e. a few minutes' silence) till she was explicitly invited by *g6.st1*, who was sensitive to *g6.st2*'s silence, to partake the discussion again. It was interesting to observe how the role distribution. *g6.st1* naturally assumed the role of moderator to ensure the continuity of discussion by asking questions like "*Do you have anything to say, g6.st2?*" or "*Can we move to the next section?*"

In summary, the quality of interaction of Group6 with the synchronous communication medium was much higher than the asynchronous media. Their interactions were highly task-oriented, leading to some progress of the task. They showed mutual respect and were quite sensitive to each other's feelings.

5.5 Online Student Interviews

Semi-structured online interviews (Flashmeeting) with two students from Group2 and three students from Group6 were conducted in the post-trial phase. The average duration of the interview was 39.5 minutes. Verbal protocols were transcribed and analysed to assess various impacts of the trial on the students, which are summarized below with excerpts, wherever appropriate.

- *Overall positive experience:*
 - Befriended people from different countries
 - Learned to use new tools
 - Acquired specific experiences
 - Improved English
- *Perceived competencies gain (cf. Section 2.2.3)*
 - Autonomy and self-directed learning competence

“I learned what to do on my own, and how to move on in the project and deal with other people working together. In the local situation whenever problems come up we would go to see the teacher. Here in the trial, we have to work out the solution on our own”

- Technical know-how and increased self-confidence
“Technically I learn more in this international way. Right now we got cultural experience. I didn’t learn about making questionnaire, of which I’d have learnt more when I was with my group mates here in Estonia. But I got experience that I’d never got in anywhere in Estonia. And I learned about the issues that whenever in the future I need to do that kind of thing, or develop anything or work in the internet, I have so much knowledge how to do it, how to do it effectively.”
- *Overall negative experience*
 - Unmotivated and busy members
“We had quite a very big problem with communicating. I think that some people are not really convinced if they want to work in this ... Some people were not interested in it, they don’t want to create the questionnaire.”
 - Coordination and communication problems
“It’s hard to find the time suited everybody. One of us is working full time.”
 - Technical constraints
“I can’t see the real reaction of the group mates. Sometimes it’s difficult to work with the Internet without direct contact.”
- *General findings about tool uses*
The interviewees’ comments showed that the tools provided were perceived to be useful and usable; these users were basically satisfied with the tools and showed strong intention to use them in the future. Specifically, the synchronous communication tool, Flashmeeting, was preferred by all the five interviewees. In response to the question which tools they intended to use for future online collaborative learning, one interviewee remarked that:
- *Task-expertise match*
The level of difficulty of the given task – developing a questionnaire – was perceived to be appropriate. It was regarded as meaningful and useful and had individual as well as social aspects, i.e., one can partially solve the task on one’s own but the completion of the task entails others’ contributions. However, due to the students’ heterogeneous backgrounds, the integration was found to be hard.
- *Facilitation and non-intervention approach*
While the students were highly satisfied with their local facilitators, whom they met face-to-face on a regular basis, they were somewhat frustrated by their remote facilitators (or group supervisors).

In fact, the students’ attitudes towards non-intervention (or self-directed learning) approach were ambivalent, as illustrated by the following excerpt:

“If we have much more precise instructions, we can work better and we have much more motivation to do this. On the other hand, the freedom is also important, if we are adult people we should choose what we want to work about. We should have freedom. I don’t know ... more instruction it can be good because we know what to do next. It simply helps us be prepared for the future.”

6. DISCUSSION

6.1 Methodological Issues

Triangulation of the multi-source and multi-perspective data is proved to be indispensable. A distorted picture would be obtained if the data from a single source were interpreted. For instance, an erroneous conclusion that the students were cognitively inert could be drawn if only the results of content analysis on their emails were considered. Nevertheless, it is very challenging to jig-saw a complete picture, especially when some data are inaccessible. Apart from the technical constraints, personal factors hindered data capture, e.g., some facilitators tended to minimize any extraneous interference engendered by the data collection procedure. Indeed, the two target groups did somewhat change their behaviour when they were aware of being observed, e.g. Group2 grudgingly posed messages to their group-blog. Such an ‘observer effect’ can possibly be mitigated with automatic data collection, a procedure to be implemented for the subsequent trial. Beside data collection, analysis of qualitative data is deemed challenging. We modified and applied Henri’s [11] coding scheme to the emails of both target groups. For Group6, the inter-rater agreement was found to be fair for the category “Participatory Activity” ($kappa = 0.69$) and low for “Interactivity” ($kappa = 0.36$). Specifically, the segmentation was inconsistent, which is not uncommon [22], and the interpretations about the links between message-units differed. Negotiations between the two coders and re-analyses led to higher consistency. Consequently, the average $kappa$ over the two target groups was 0.74 for “Participatory Activity” and 0.66 for “Interactivity”.

As argued earlier, the applicability of Henri’s original content analysis scheme [11] to synchronous CMC such as instant chats and videoconference dialogue seems controversial. For these types of contents, we opt for conversation analysis - a specific form of content analysis [15] aiming to unfold the dynamics and richness of conversational interactions. Understanding a chat or FM session with several participants, whose utterances are made in response to past interactions and in anticipation of future responses to come very close in time, entails an analytical method different from the one used for understanding a set of email exchanges with relatively longer temporal gaps. Nonetheless, the increasing fuzziness of content types (e.g. multimodal interaction) engendered by the ongoing information revolution renders the choice of analysis methods and their uses more challenging. One persistent challenge is the reliability and validity issues. While the former may be mitigated by structured well-defined coding schemes and systematic training of coders, the latter is recalcitrant as even actors themselves cannot definitely testify their ephemeral thoughts and feelings that researchers infer from their verbalizations and gestures.

6.2 A Posterior Research Questions

Trial-1 was primarily exploratory. We have nevertheless identified several *a posteriori* research questions (R) into which the empirical data reported above can provide some insights. A caveat is that we tend not to generalize our findings based on a subset of participants to the entire sample.

RI: Which role did cultural factors play in the process and outcomes of the collaborative learning activities in the context of Trial-1 (Section 2.2.1)?

Language is identified as the most perceptible cultural factor, which influences all the three aspects of interaction – social, cognitive and affective (Table 1). None of the students is a native English speaker. The first survey showed that the students' self-assessed English proficiency was medium with 2.7 (out of 5 the highest). The interviews showed that some students of the target groups were not confident about their written English and shy of speaking it. Presumably the students would have been more responsive if the language barrier did not exist. Nonetheless, the collaborative activities proceeded. However, whether the effectiveness and efficiency in terms of the quality of the joint artefact produced and the time required for completing it will be higher in a mono-linguistic OLE remains an empirical question to explore. In fact, the findings of previous research on this specific issue are inconsistent [e.g. 1, 24]. Other cultural differences (e.g. lifestyle) were perceived to be positive factors for making the group interaction more interesting than otherwise, but they had no visible impact on the quality of the task per se. The data of the all the eight groups showed that the students could manage their work regardless of the differences in time zone and curricula.

R2: *Were the specific characteristics of the OLE so structured as Trial-1 conducive to self-directed learning (SDL) (Section 2.2.2)?*

With minimal interventions from their group facilitators, these students were able to complete the task. While such a SDL approach seemed effective for these two groups, one may query about the efficiency. As reflected in the interviews, the students were ambivalent about the issue "structured vs. freedom". In fact, in the focus group session with the facilitators (details are reported elsewhere), some of them queried whether they should have intervened in the activities of the groups that they were supervising. One facilitator, who was more active in interacting with her groups, remarked that SDL entails relevant basic knowledge and skills and thus should be preceded by scaffolding and that it was hard to strive for the balance between teacher-led guidance and student SDL. Clearly, it depends on the readiness and mindsets of both students and facilitators. In fact, the facilitators, who had never worked in an intercultural OLE prior to Trial-1, could have fulfilled their role better if they had negotiated their own expectations and understanding about SDL more openly in the course of the trial.

R3: *What kinds of communication patterns emerged under the specific constraints of Trial-1 (Section 2.2.3)?*

The SNA of the data from the Communication Diary, blogs and emails indicate that the communication patterns were largely determined by the collaborative phase, be it group formation, theme identification or question selection. The quality of interaction, which manifests in terms of cognitive, social and affective aspects (Table 1), varied with the tool. While blogs and emails supported social and affective communication, Flashmeeting and MSN chat enabled cognitive engagement. Besides, the adoption of the non-interference approach could partially explain the low involvement of the facilitators in the student group activities, as shown by the sociograms of one target group. It is speculated that the other groups with the more/less active facilitators would portray different pictures. Further, as indicated by the data of the two target groups, the four building blocks (Figure 1) could be established: members whose common need to interact with international peers were integrated into and fulfilled through the group's online activities supported by the selected communication tools, thereby leading to some emotional

bonds, which varied in strength with individual students. Consequently, social networks were built, enabling the students to exchange ideas and information and to acquire the competencies of using English and tools, to interact in the heterogeneous group and to engage in self-directed learning.

R4: *Which personal factors of student participants correlated with their task performance in Trial-1?*

As explained earlier, the group questionnaire was expert- as well as peer-reviewed and the activities of each student were assessed by their team mates, resulting in a final grade. It was intriguing to know whether this indicator of task performance correlated with the students' demographic variables. No correlation was found between the grade and the students' self-assessed English proficiency, or their self-assessed ICT experience or their motivation. Besides, there was no significant difference in the final grade between the students majored in computer science and those majored in other domains, or between undergraduate and postgraduate students, or between students who have had some group work experience and those who haven't, or between students who have had some online course experience and those who haven't. This "non-significant phenomenon" could be the artefact of the assessment procedure. First, the students were unprepared for it; peer review entails relevant background knowledge and proper training. Second, some students were reluctant to assess their team-mates and tended to grade leniently. Third, the facilitators might not know their remote students well enough to grade accurately. These undesirable factors tend to undermine the validity of the final grade as an indicator for the students' actual task performance.

R5: *Which implications could be drawn from Trial-1 experiences to general design of OLE?*

While no prescriptive guidelines can be formulated, several issues are worthy of serious consideration in designing OLE:

- (i) Careful selection of right student participants to minimize the risk of demotivating the group morale by uncommitted or busy members. This addresses the issue of voluntariness, which is strongly linked to learners' motivation and in turn determines their technology acceptance [18]. Volunteer students and facilitators are desirable.
- (ii) Equal access to the selected tools. Participants should be fully informed about the availability, strengths and limits of individual tools, enabling them to make informed choice.
- (iii) Systematic training of tool uses to attain certain threshold;
- (iv) Cautious task selection for a heterogeneous group to reduce bias for students with particular backgrounds; involving students in task selection to enhance the sense of ownership;
- (v) Moderately structured setting with precise instructions, thereby enabling students to prepare themselves better and fostering their motivation;
- (vi) Inter-cultural but intra-disciplinary - this point is controversial. While mutual stimulation can be promoted in a group with different academic backgrounds, the knowledge gap should not be too large to be bridged lest it would lead to communication breakdowns and frustration.

6.3 Concluding Remarks

As corroborated by the interviews with the students and the facilitators, our OLE enabled the participants to gain unprecedented experiences of online collaboration and to advance

critical competencies such as self-directed learning. This is beneficial for their future work, given the ever-increasing importance of cross-cultural technology-enhanced learning. Nonetheless, several limitations identified in the first trial should be addressed. First, technical issues, for instance, the Communication Diary could basically capture the students' communication data, but it relied heavily on their memory and motivation and thus might be prone to data fabrication and user attrition. Mashups combining some appropriate Web applications in a single user interface and automatic logging the usage of these applications is a plausible solution that may not only increase the validity of the communication data but also enable the students to deploy the applications by eliminating the tedium to switch between tools. Second, organizational issues, for instance, the harmonization of core actors' (incl. researchers, facilitators and students) needs, expectations and constraints entails very early planning and ongoing negotiations. Particularly sensitive is the issue of student assessment that can strongly affect the students' motivation and interfere with the institution's accreditation policy. Third, economical issues, for instance, whether the resources (time, effort) consumed can be justified by the gains acquired (experiences, competencies) for establishing a complex OLE (i.e. cost-effectiveness; [23]) remains an empirical question to address in our future work.

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