Technology, Pedagogy and Education

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Published online: 06 Aug 2014.

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In this exploratory study, the authors introduced an interculturally enriched collaboration script (IECS) for working in culturally diverse groups within a computer-supported collaborative learning (CSCL) environment and then assessed student online collaborative behaviour, learning performance and experiences. The question was if and how these variables differed for the groups that used an IECS versus groups that used a general collaboration script (CS) that did not include intercultural elements. Using a web conferencing tool, 47 students from a university in Ukraine and a university in the Netherlands worked together in groups to develop project plans on an environmental problem. The groups in the IECS condition showed a higher frequency of so-called contributing behaviour but a lower frequency of planning behaviour, seeking input and social interaction than the groups in the CS condition. The IECS groups also produced better project plans than the CS groups. Future study using a similar experimental set-up but with larger samples is recommended to see if the present results can be replicated.

Keywords: computer-supported collaborative learning; cultural diversity; interculturally enriched collaboration script; higher education; international learning

1. Introduction

Today's information and communication technologies (ICT) have made it possible for universities to enlarge their international student communities, advance and enhance the attractiveness of their courses by offering distance learning programmes, make both teachers and students mobile and – last but not least – enhance intercultural awareness. However, the use of ICT in learning environments involving students collaborating from different cultural backgrounds brings both benefits and challenges. Among the benefits are the sharing of culturally diverse knowledge and hands-on preparation for working in an international climate. Among the challenges are the coordination of different attitudes, styles of communication and patterns of behaving. In this sense, it is important for educators to have access to learning environments that accentuate the positive aspects of such collaborative learning and reduce the potentially negative aspects. This study discusses and illustrates how knowledge of intercultural differences and the possible impact of these on group

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collaboration processes can be used to inform the design and implementation of learning environments that are responsive to the intercultural context of collaborative learning.

Within the context of online collaborative learning, culture-related factors can impede the online group interaction process in terms of the coordination difficulties, differences in perceptions of the types of actions that are required and likely to be effective in a given learning situation, and communication difficulties (e.g. Popov et al., 2014; Weinberger, Clark, Hakkinen, Tamura, & Fischer, 2007). Particularly, process losses due to coordination difficulties have been reported to be one of the major impediments to online collaboration in general (Strijbos, Martens, Jochems, & Broers, 2004) and online collaboration between culturally diverse students in particular, because of their culture-related differences on how to act and interact (Anderson & Hiltz, 2001; Lim & Liu, 2006). Group members are often challenged by procedural issues related to coordination, evaluation of ideas, planning and task division when it comes to decision making at any stage of group work – no matter what the composition of a collaborative group. Culturally heterogeneous groups need to handle all these issues as well, as they are likely to experience challenges related to agreeing on 'legitimate' approaches to problem-solving, uncertainty associated with working with people from different cultural backgrounds, and miscommunications (Behfar, Kern, & Brett, 2006). It has been suggested that the bigger the cultural gap between learners in a group, the greater the probability of miscommunication in general and in an online learning environment in particular (Reeder, Macfadyen, Roche, & Chase, 2004).

The difficulties that characterise culturally heterogeneous groups often result in decentralised thinking, divergence in collaborative learning activities, and misunderstandings (Popov et al., 2014; Uzuner, 2009). These difficulties can also be understood as consequences of both differences and taken-for-granted issues by different actors, especially in relation to the collaborative learning processes. When the culture-related factors are sufficiently articulated and integrated, students can work effectively in culturally heterogeneous groups.

Numerous studies have provided insight into computer-supported collaborative learning (CSCL), which can be defined as the negotiation of meaning and the shared construction of knowledge among students interacting with the help of technology (Kreijns, Kirschner, & Jochems, 2003; Stahl, Koschmann, & Suthers, 2006). CSCL does not eliminate the influences of culture on the collaborative learning process, however, and introduces some challenges of its own (Lim & Liu, 2006; Popov, Biemans, Brinkman, Kuznetsov, & Mulder, 2013). Despite significant progress in the field of CSCL research, little is known about the support that is needed to help culturally diverse groups of students collaborate and thereby benefit from the sharing of knowledge and experiences. Based on previous research showing the effectiveness of using collaboration scripts to support online collaboration (e.g. Fischer, Kollar, Stegmann, & Wecker, 2013; Kollar, Fischer, & Hesse, 2006; Rummel & Spada, 2005; Weinberger et al., 2007), we assumed that students collaborating from different cultural backgrounds could benefit from the use of an interculturally enriched collaboration script (IECS) – that is, a collaboration script that serves to structure a group's interaction, coordinate learning activities and articulate culture-related differences in perspectives and behaviour. The purpose of this study was therefore to (1) design an IECS for use in a CSCL environment and (2) document the effects of using this IECS on the *online collaborative learning behaviour*

(i.e. the performance of activities needed for joint problem-solving and collaborative learning), *learning performance* (i.e. the extent to which learners achieve specific goals in the form of individual learning gains and/or final group products) and *experiences with CSCL* (i.e. the ways in which collaborative interactions have been made sense of by students).

1.1. Issues of culture within a computer-supported collaborative learning environment

In the present research, we investigated collaborative learning from a social constructivist perspective. Viewed from this perspective, the backgrounds and cultures of learners can be assumed to shape a collaboration process and the acquisition of knowledge (Vygotsky, 1978; Zhu, 2009). Culture can be defined as 'the collective programming of the mind which distinguishes the members of one human group from another … the interactive aggregate of common characteristics that influence a human group's response to its environment' (Hofstede, 1980, p. 25). Within the context of online collaborative learning, culture can be assumed to be among the factors that shape the individual student's understanding of the collaborative learning tasks, communication and behaviour (Zhu, 2009).

The Individualist–Collectivist (I–C) cultural orientation as put forth by Hofstede (1991) has been widely used to describe culturally based differences in collaborative group processes (e.g. Cox, Lobel, & McLeod, 1991; Oetzel, 2001; Vatrapu & Suthers, 2007). The I–C cultural orientation has been shown to be valid in more than 1500 published studies (Metcalf & Bird, 2004) and to identify: (1) the degree of dependence on the self (individualists) versus the group (collectivists); (2) attitudes towards goals with individualists geared more towards personal goals and collectivists geared more towards group success and (3) the motives underlying behaviour with collectivists acting more on the basis of shared group identity, social norms and commitment to the group while individualists act more on the basis of own values, beliefs and motives (Hofstede, 1991).

In Table 1, the findings of studies that have applied the I–C continuum to collaborative learning processes are summarised. The I–C cultural orientations have also been used to investigate the functioning of culturally diverse students in an environment that involves CSCL (for overviews, see Tapanes, Smith, & White, 2009; Vatrapu & Suthers, 2007; Weinberger, Marttunen, Laurinen, & Stegmann, 2013). In recent research, Vatrapu and Suthers (2007) claimed that students from individualist cultures are more likely to see the collaborative learning environment as a medium to jointly identify problems and discuss conflicts in knowledge beliefs while students from collectivist cultures are more likely to view the collaborative learning environment as a place to share information and explanations. The results of survey and focus group data in the study of Gunawardena et al. (2001) showed that cultural orientation of individualism and collectivism was one of the main factors influencing online group process, as well as in the 'norming' and 'performing' stages of group development.

1.2. The use of collaboration scripts to promote effective collaboration

The use of collaboration scripts within a CSCL environment has been found to provide particularly effective support (for overviews, see Fischer et al., 2013; Kollar et al., 2006). Collaboration scripts can be used to scaffold the interactions and

Table 1. Summary of individualist and collectivist orientations towards collaborative learning.

Individualists	Collectivists	Literature sources
Nature of task-related behaviour		
Task oriented	*Relationship oriented*	Cox et al., 1991; Hofstede
Individualists tend to exhibit more task-oriented activities and focus on content-related background of group members.	Collectivists tend to focus on group norms and group interrelations.	et al., 2010; Kim & Bonk, 2002; Oetzel, 2001; Shi et al., 2013; Tapanes et al., 2009
Nature of conflict-related behaviour		
Competitive behaviour	*Cooperative behaviour*	
Individualists are more likely to exhibit competitive behaviour focused on personal achievement.	Collectivists are more likely to avoid conflicts and demonstrate predominantly cooperative behaviour.	
Nature of social and cognitive behaviour		Gunawardena et al., 2001;
Open to disagreement	*Preference for consensus*	Hall, 1990; Hofstede et al.,
Individualists are more inclined to identify and discuss conflicts in knowledge and beliefs. They tend to express more opinions independent of group members.	Collectivists are more inclined to identify and discuss points of consensus. They tend to adapt their personal intentions and goals to those of the group, conform to expectations of their group members.	2010; Setlock et al., 2004; Shi et al., 2013; Tapanes et al., 2009; Vatrapu & Suthers, 2007
Type of communication style		
Direct	*Indirect*	
Individualists tend to structure their online contributions in an explicit, direct manner with a focus on main points. They also tend to be more literal.	Collectivists tend to be indirect and implicit. They place greater emphasis on context and details than on main issues and explicitness.	
Nature of reason-giving		Nisbett, 2003; Vatrapu, 2008
Analytic	*Holistic*	
Individualists tend to argue for a more differentiated, analytic solution that also seems most logically viable.	Collectivists prefer a final solution that is highly inclusive.	

learning of students working in a CSCL environment by clarifying the roles to be played and spelling out the required sequence of activities (Carmien, Kollar, Fischer, & Fischer, 2007). Collaboration scripts can initiate the types of interactions that are needed for productive task performance (Kollar et al., 2006). And collaboration scripts can be conveyed via explicit instruction (e.g. oral presentation by the teacher, written presentation/handout) or embedded in the learning environment itself (e.g. graphic representations, textual cues, response prompts).

In 2005, Rummel and Spada (2005) integrated the empirical findings from research on communication and computer-mediated collaboration to create a cyclic model of online collaboration that encompasses the processes necessary for

successful collaborative problem-solving. There are three phases in the model: the initial, main and final phases. In the initial phase, the collaborating students orient themselves towards the learning task, become aware of each other's backgrounds and establish a shared understanding of the problem at hand. In the main phase, the collaborating students articulate their points of view, discuss their points of view, reflect upon contributions and address all topics of relevance to the learning task. In the final phase, the students strive to find the most viable solution to the problem by weighing all options using a particular system of evaluation (e.g. making calculations, fitting data to a model) or specific criteria. The cyclic model of Rummel and Spada (2005) has been shown to effectively promote online collaboration and is therefore drawn upon in the present research.

1.3. The present research and specific questions

In order to promote effective collaboration and bridge the cultural gap between learners collaborating online, we developed an interculturally enriched collaboration script (IECS) that includes exactly the same collaboration steps and instructions as a general collaborative script (CS) but is supplemented with elements developed specifically for culturally distinct groups. Building on previous research on intercultural differences (see Table 1), we identified specific discourse practices and interaction patterns that were likely to emerge in culturally heterogeneous CSCL groups. We then tailored our IECS to students with an individualist orientation (i.e. Dutch students) and students with a collectivist orientation (i.e. Ukrainian students) for purposes of the present research (see section 2.3. of this paper for more details regarding the students' cultural backgrounds). We then compared the effects of using an IECS versus a general CS for students working in a CSCL environment. In doing this, we asked ourselves the following questions:

> RQ1. Do differences occur in *the online collaborative behaviour* of students working in culturally heterogeneous groups using an interculturally enriched collaboration script versus a general collaboration script in a CSCL environment?

> RQ2. Do differences in *learning performance* manifest themselves for students working in culturally heterogeneous groups using an interculturally enriched collaboration script versus a general collaboration script in a CSCL environment?

> RQ3. What do students think about their *CSCL experiences* and the usefulness of an interculturally enriched collaboration script relative to a general collaboration script?

2. Method

2.1. Participants

Participants were second-year Bachelor students enrolled in educational programmes in the field of life and environmental sciences in either the Netherlands or Ukraine. Of the 47 students, 23 were enrolled in the Netherlands (19 from the Netherlands, 3 from Germany, 1 from Curacao) and 24 in Ukraine; 65% were women. The students from Germany and Curacao had been living in the Netherlands for an average of two years, spoke fluent Dutch and had received most of their university education in Dutch. The age of the participants ranged from 18 to 23 years, with a mean of 19.6 (SD = 1.2). All of the study participants had proven English language proficiency when they enrolled at the university.

2.2. *Research setting and assignment*

The International Study Visits Environmental Sciences course was chosen for a case study because the course requires students from the Netherlands and Ukraine to collaborate on a two-week project. During this course, the students studied two major environmental disasters, Chernobyl and Fukushima, in connection with the theme of 'radioactivity and nuclear power'. During the first week, the students interacted online to prepare for the projects at their home institutions. During the second week, the Dutch students visited Ukraine (Kiev) to complete the project on a face-to-face basis. Given our interest in the students' online collaboration for purposes of the present study, only their group work during the first week of the project and thus their online interactions were analysed.

After the first week of the project, the students were expected to be able to: (1) develop a project plan to study an environmental problem; (2) actively participate in online group work in consultation with faculty and students and (3) apply knowledge of environmental sciences to a project together with foreign students. The main output from the first week was a group presentation of the plan developed to study the environmental problem. For both the Dutch and Ukrainian students, the course was mandatory. And to pass the course, the students had to actively collaborate in their groups and present their final results.

2.3. *Study design and procedure*

A randomised two-group research design was used to explore the differences between culturally heterogeneous groups of students working in a CSCL environment using an interculturally enriched collaboration script versus a general collaboration script (see Figure 1).

Three students from the Ukrainian university and three students from the Dutch university were randomly assigned to one of two conditions (i.e. IECS or CS). One group using CS ended up including three Dutch and two Ukrainian students. A total of seven groups of six and one group of five students worked online in sessions of
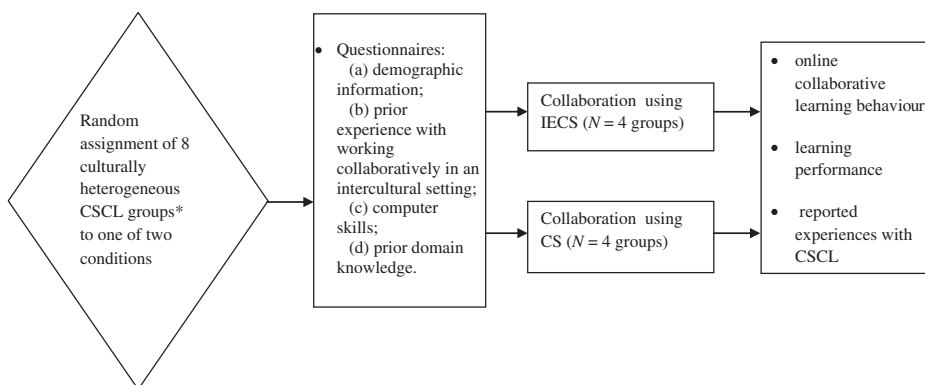
*Each group consisted of three students from Ukraine and three students from the Netherlands; one group using CS ended up including 3 Dutch and 2 Ukrainian students.

Figure 1.   Outline of research design.

one and a half to two hours on average across a period of three days. The students interacted with the study personnel and with each other in English. Prior to the actual study, several questionnaires were sent to the study participants to gather information on control variables.

Students' cultural backgrounds were determined by asking them to indicate their countries of origin. Countries of origin were coded according to Hofstede's Individualist–Collectivist dimension (individualism [IDV] index, see Hofstede, Hofstede, & Minkov, 2010), standardised and set into a range from 0 (most collectivistic) to 100 (most individualistic). We followed previous research (e.g. Gouveia, Clemente, & Espinosa, 2003; Murray-Johnson et al., 2001; Popov et al., 2012, 2014) in dichotomising the IDV index. Since Hofstede (Hofstede, 1991; Hoftede et al., 2010) did not investigate Ukraine in his studies, scores for cultural orientation here were used from a study conducted by Prykarpatska (2008) (i.e. for the IDV index the Ukrainian score is 38, whereas the score for the Netherlands is 80). As in these previous studies, we ranked students in our sample by the IDV index scale. Thus, the Ukrainian students were considered as collectivists and the Dutch students as individualists.

The initial phase consisted of two consecutive online group sessions with a one-hour break for lunch in between and occurred on the first day of the project. The students were introduced to the Adobe Connect program, the assignment and the collaboration procedures. Each student received paper-based instructions for either the IECS or CS and was specifically asked to follow the script instructions.

On the second day, the main phase of the collaborative work was conducted and consisted of two consecutive online group sessions with a one-hour break for lunch in between. It was composed of three subtasks: (1) discussion of the background literature; (2) definition of the focus, scope and research question for the project; and (3) outline of a strategy to collect the data needed to answer the research question.

On the third day, the final phase consisted of one online group session and one plenary session for the group presentations. The students had to finalise their project plan and present it in a maximum of 10 minutes via videoconferencing. After the final phase, the students received a short debriefing, which included informal discussion of both content and process issues confronted during the group work.

Within two days of completion of the first week of the project, 20 students (5 Dutch and 5 Ukrainian from the CS condition plus 5 Dutch and 5 Ukrainian from the IECS condition) were randomly selected for an individual interview to find about (a) their CSCL experiences and (b) script adherence. The semi-structured interview had a duration of 30 minutes on average.

2.4. Learning platform

The students were seated at individual computers in separate classrooms, which were located in the Netherlands and Ukraine for all online group sessions. Their only contact was via a web-conferencing tool, Adobe Connect. On the starting page, the students could see the so-called 'pods' of Camera, Chat and Share (Figure 2). All group members could see and hear each other using the Camera with Voice pod. The Chat pod was an ordinary chat facility. The Share pod allowed the students to share documents. Students could also prepare a presentation together using this pod. Each online group session was recorded with the help of Adobe Connect features provided for this purpose.
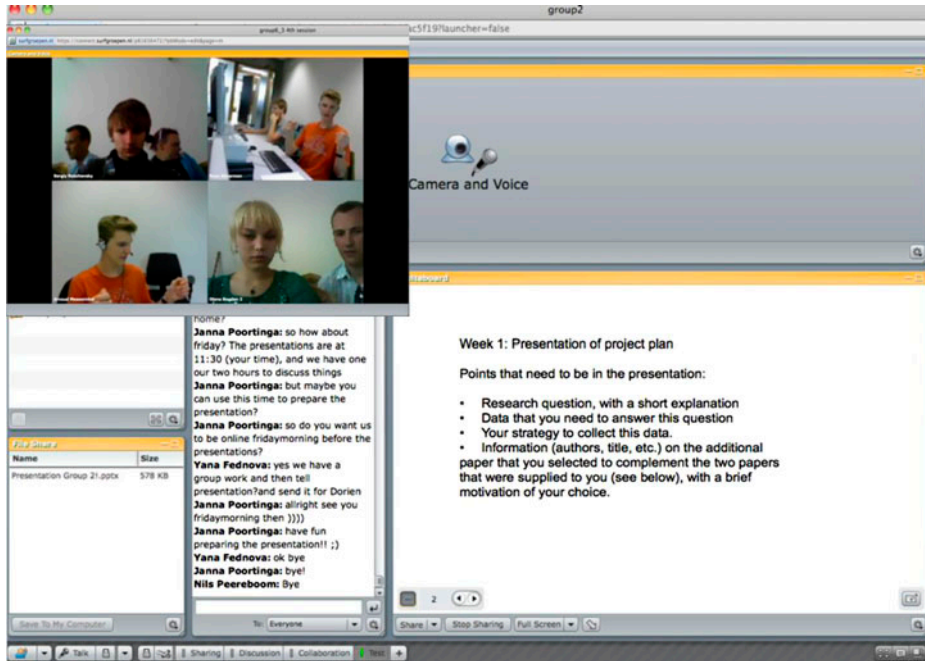
Figure 2.   Screenshot from the web conferencing tool Adobe Connect.

2.5. *Design of the CS and IECS*

The general CS provided instructions on WHAT to do during each step of the online collaboration part of the project. The IECS provided three types of instructions for each step: (1) general instructions on WHAT to do, which is the same as in the CS; (2) instructions on HOW to proceed with a particular subtask and (3) explanation of WHY that particular subtask was important.

The 'WHAT to do' script instructions helped coordinate learning activities by giving step-by-step guidelines and timelines for the subtasks. An example is: 'Please use the following 25 minutes to take individual notes while answering the questions. These questions will help you to formulate the focus of your project plan.' These instructions were then followed by those for the next subtask. For instance, 'Please use the following 60 minutes to exchange individual answers and ideas. Identify and discuss differences and similarities between the different answers and try to reach an agreement on the focus of your project plan.' Figure 3 provides an overview of the general CS used in this study.

The 'HOW to proceed' and 'WHY' parts of the IECS instructions were aimed at stimulating specific interactions among culturally heterogeneous groups of students, increasing the frequency of specific behaviours and thereby facilitating the collaboration process. The IECS instructions were tailored to students with a more individualist orientation (i.e. Dutch students) and students with a more collectivist orientation (i.e. Ukrainian students) (see Table 1). The specially tailored instructions for how to approach group members and how to engage in a collaborative discourse were expected to enhance mutual understanding, engagement in debate and convergence on the steps to be taken to complete the collaborative learning activities.
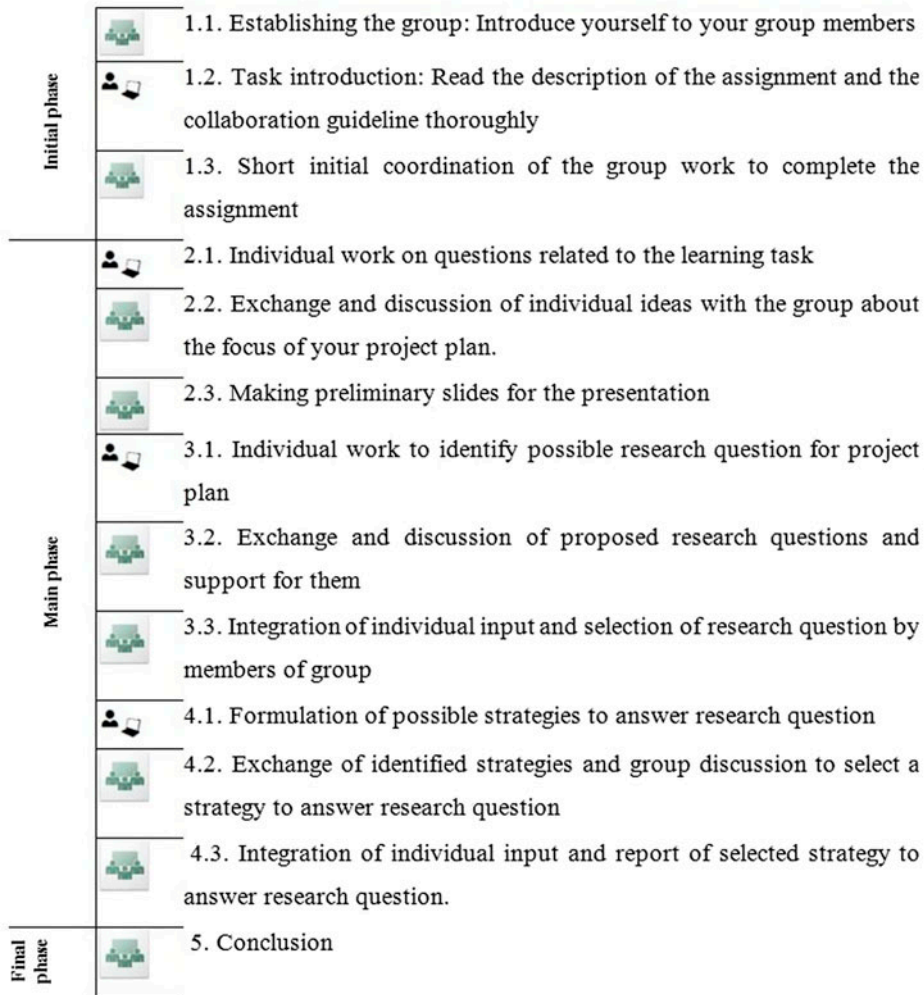
Figure 3.   An overview of the general collaboration script.

In the following, we describe the sequence of activities to be performed by the students. In Table 2, we present an excerpt of the IECS pertaining to collaboration steps 2.1–2.3.

2.5.1. Initial phase

In the initial phase of the collaboration process (Figure 3, steps 1.1–1.3), the students were asked to create personal profiles, orient themselves towards the learning task and establish a shared understanding of the problem. Given that group members with a largely individualist orientation can unintentionally offend individuals from a collectivist orientation by omitting aspects of social interaction owing to a focus on the task at hand (Hofstede et al., 2010), we intentionally had the students create personal profiles during the initial phase of the collaboration process. The IECS but not the CS thus included questions that addressed the personal backgrounds of the students in addition to their previous content- and task-related experiences. The group members

Table 2.   Excerpt of steps 2.1–2.3 from the IECS.

Main phase	General instructions	Cultural instructions tailored specifically to Ukrainian students	Cultural instructions tailored specifically to Dutch students
2.1 Individually answer questions on group-specific papers	Please use the following 25 minutes to take individual notes while answering the questions. These questions will help you to formulate the focus of your project plan. Questions can be found on page 5 of the group assignment.	A. Try to be as specific as possible when answering the questions. Provide sound argumentation for your choice. B. **Why this is important:** The purpose of this step is to individually identify an approach to answer the research question that you defined.	A. Try to give more context information when preparing your answers (i.e. what is your reasoning behind your potential research question). Try not to rush with taking actions. B. **Why this is important:** The purpose of this step is to individually answer questions on group specific papers.
2.2. Exchange of individual ideas with the group	Please use the following 60 minutes to exchange individual answers and ideas. Identify and discuss differences and similarities between the different answers and try to reach an agreement on the focus of your project plan.	A. Feel free to disagree with your group members and be direct and specific as much as possible. There is no right or wrong answer for solving this task as long as you can prove your point. Try to support your ideas by providing additional support, explanation, evidence (i.e. examples or reference to some literature) and elaboration of an argument. Try to spell things out exactly when talking about your point. B. **Why this is important:** The purpose of this step is to exchange notes, discuss the individual ideas and share knowledge and information with your group. The best way to do this is by asking your fellow students to share their ideas about how to solve the	A. Allow adequate time for communication. This means taking time to fully understand the message and giving your group members time to think of a response. Try to see this online communication as a way of exchanging information, ideas and opinions but also as a form of engaging your group members. Try to share, as much as you can, with your fellow students about information/ideas that you can think of on how to solve the task. B. **Why this is important:** The purpose of this step is to exchange notes, discuss the individual ideas and share existing knowledge and information with your group. The best way to do this is by giving information and by asking your group members to

Table 2.   (*Continued*).

Main phase	General instructions	Cultural instructions tailored specifically to Ukrainian students	Cultural instructions tailored specifically to Dutch students
		task. Together with your group members you need to come up with a list of similarities and differences in your answers and corresponding argumentation. <u>Your task is to identify differences.</u> Try to resolve these differences and reach an agreement with your group members on the focus of your project plan.	share their ideas about how to solve the task.Together with your group members you need to come up with a list of similarities and differences in your answers and corresponding argumentation. <u>Your task is to identify similarities</u>. Try to reach an agreement with your group members on the focus of your project plan.
2.3. Make preliminary slides for presentation	Based on your group discussion, please use the following 20 minutes to make a few preliminary slides for the presentation. Prepare PowerPoint presentation and put it in the 'shared documents' (on the left side of the screen of Adobe Connect). It can be opened in the plenary room.	A. Try to be analytic and logical while formulating a research topic to work on. Try to focus on research questions that seem the most logical and viable for this particular case/task. Try to reach an agreement with your group members in this regard. B. **Why this is important**: The purpose of this step is to formulate a research topic that you will be working on based on previous group discussion. Try to make your research question as specific as possible. Provide a summary of the discussed ideas/ possible solutions by combining all contributions and integrating them into a single PowerPoint slide.	A. Try to be inclusive while formulating a research topic to work on. There is no concrete answer to this task; therefore be open to see the approaches to the task in very diverse ways. Try to reach an agreement with your group members in this regard. B. **Why this is important:** The purpose of this step is to formulate a research topic that you will be working on based on previous group discussion. Provide a summary of the discussed ideas/ possible solutions by combining all contributions and integrating them into a single PowerPoint slide.

were asked to exchange their personal profiles and discuss the similarities and differences between them. The Ukrainian students were further instructed via the IECS to construct a concrete idea of themselves and the other members of the group on the basis of the knowledge and experiences shared with regard to the content of the assignment; the Dutch students were further instructed via the IECS to get to know the other members of the group in terms of their personal backgrounds and build a relationship of trust for solving the task together.

2.5.2.   Main phase

In the main phase of the preparatory collaboration process (Figure 3, steps 2.2, 3.2 and 4.2), the students were instructed to exchange and discuss their individual ideas with regard to the assignment (step 2.2), the question to be answered (step 3.2) and the strategy to be followed to answer the question (step 4.2).

In Ukraine, the teacher-centred didactic approach is still prevalent in many universities (Woldan, 2009). Since Ukrainian participants belong to a collectivistic culture (Prykarpatska, 2008) Ukrainian e-learners might rely heavily on a teacher, which could prove problematic as teacher presence is very limited in the e-learning environment (Vatrapu & Suthers, 2007).

As to the Netherlands, e-learning forms of education were introduced in higher education in the 1990s. In the Netherlands, the student-centred didactic approach is applied to a greater extent. Students from the Netherlands are well equipped for exploratory learning methods, in that learners usually take control of their own learning and knowledge is seen as rich and multidimensional.

The Ukrainian students were specifically instructed via the IECS to feel free to disagree with their partner and to be as direct and specific in their feedback as possible (e.g. 'Feel free to disagree with your group members. There is no right or wrong answer for solving this task as long as you can justify your point. Support your points of view by providing examples or references to the literature'). The Dutch students were not only instructed via the IECS to share information and ideas on how to solve the task but also that the best way to do this was to ask their partner to share information and ideas as well (e.g. 'Allow adequate time for communication. This means taking time to fully understand the contributions of others to questions and giving group members time to think of how to respond. Try to share as much as you can about ideas and how to solve the task with your fellow students').

The cultural communicative styles of the participants were expected to affect the extent to which they would present information, reflect upon this, and elaborate upon it. The Ukrainian students were therefore explicitly instructed via the IECS to be as direct and specific as possible; to spell things out when talking about a point; and to provide information to support their points of view (e.g. 'Speak your mind and focus on the main points when discussing with your group'). The Dutch students were instructed to try to give contextual information when presenting their ideas and to explain the reasoning behind their ideas in order to facilitate the understanding of the presented information.

2.5.3.   Final phase

During the final phase of the preparatory collaborative process (Figure 3, steps 2.3, 3.3, 4.3 and 5), the students were instructed to summarise and synthesise their

contributions and discussion to come up with a joint plan to gather the information needed to answer the agreed-upon research question and thus complete the group assignment.

Cultural differences might influence how the group members want to reach decisions and conclusions (Nisbett, 2003). The Dutch students were therefore instructed via the IECS to be as open as possible while working on the solution to the problem and to consider alternative viewpoints (e.g. 'It is possible that there is no concrete answer to this task; be open to see the approaches to the learning task in very diverse ways'). The Ukrainian students were instructed via the IECS to be as specific as possible while integrating ideas to come up with a joint solution to the problem (e.g. 'Try to be logical while formulating your joint project plan. Focus on approaches that seem logical and viable for the particular problem when answering the research question'). All of the students in the group receiving the IECS were further instructed that, even though they may have opinions that differ from each other, assignment success depends on how well these differences are resolved to reach agreement on a project plan.

2.6. *Measures*

2.6.1. *Online collaborative learning behaviour*

All of the online chats, including text and audio information, were anlysed using the coding scheme of Curtis and Lawson (2001), which has been widely used in studies of computer-mediated collaboration and cross-cultural collaboration (also see Kim & Bonk, 2002; Swigger, Hoyt, Serçe, Victor, & Alpaslan, 2012). Five main categories of online collaborative behaviour were identified: planning, contributing, seeking input, reflection/monitoring of medium and social interaction. Each category of collaborative behaviour had several subcategories, which are illustrated in Table 3.

Pilot testing of the coding scheme showed it to be applicable to the data collected in this study. Each utterance consisting of mainly phrases and sentences posted by the student and reflecting a specific collaborative behaviour was coded. The coding subcategory was mutually exclusive – i.e. only one subcategory was assigned to an utterance. Salutatory and closing utterances were ignored in the coding of the data. Before coding the data, two coders discussed and reached consensus on the definition of each category and its subcategories based on the descriptions and examples presented in Curtis and Lawson (2001). Both the inter-rater agreement between two independent coders (Cohen's $k = 0.82$) and the intra-coder reliability for each coder independently for 10% of the data (90% identical scores) were sufficiently high.

The absolute total scores were determined for each group for every subcategory of collaborative behaviour and then divided by the number of members to obtain a mean subcateogry score.

2.6.2. *Learning performance*

At the end of the first week of collaborative work, each group had to give a Power-Point presentation of the developed project plan; two or three members of the group did this with always a mix of Dutch and Ukrainian students for each group. Assessment concerned the quality of the students' project plans and not the quality of the presentations per se. Ten quantitative assessment criteria were developed for this

Table 3. Collaborative behaviour coding scheme of Curtis and Lawson (2001) with examples obtained from chats in present study.

Main collaborative behaviour categories	Subcategories	Examples obtained from chat protocols
Planning	*Establishing group*: encouraging group collaboration and cohesiveness	*- We will be working together for two weeks, so let's get the best out of it. Let me know if you do not understand what I say.*
	Organising work: creating shared tasks and deadlines; making suggestions	*- We can make a task division with the questions I think. We can do half and you do the other half? There are 12, so 6 for us and 6 for you, 2 per person. Then we exchange. Is this ok with you?*
	Initiating activities: scheduling activities to discuss progress and organisation of group work	*- I will prepare a draft of the PowerPoint and upload it so you guys can give feedback and we can do the presentation together on Friday.*
Contributing	*Help giving*: responding to questions and requests from others	*- To change the name of the PowerPoint, you need to click on the assignment menu.*
	Feedback giving: reflecting on partner's contributions and providing feedback on group member's proposals	*- I think your idea about policy changes after a nuclear disaster is interesting. Then we have to look closer to the role of the stakeholders in the policymaking.*
	Exchanging resources: sharing of resources and information to assist each other in a group	*- I found a very good website document. It is 245 pages, but we only need chapter 6.2. It is about management of radioactive waste from the accident in Chernobyl. So it may be handy I think.*
	Sharing knowledge: sharing existing knowledge and information with other group members	*- According to the two articles that I read, we need to focus on the impact of nuclear disasters like Chernobyl and Fukushima for the disposal of nuclear waste.*
	Explaining or elaborating: supporting one's position	*- We need to change the date to 1990–2010 because, in pre-1990 Ukraine, it was not a matter, so it should be considered on the scale of the USSR.*
	Challenging: challenging the contributions of group members and seeking to engage in debate	*- I disagree with you about the reactor type thing because we have to take into account that there are more types of reactors, and thus more types of nuclear waste. What do you think?*
Seeking Input	*Help seeking*: request for assistance from group member(s)	*- Do you know how to upload a Word document in this program? I can't find a chapter on the effects of different levels of radiation on plants in the Hinton article.*
	Feedback seeking: seeking feedback on a position advanced	*- Do you agree with the first subquestion?*

(*Continued*)

Table 3.　(*Continued*).

Main collaborative behaviour categories	Subcategories	Examples obtained from chat protocols
	Advocating efforts: urging others to contribute to the group effort; requesting information	- *because then in the Netherlands there was a lot of protest. I don't know how that was in the Ukraine..?* - *When do you think that you can get the information on policies? We need to know if it is possible, and which plant we can use to compare.*
Reflection/ Monitoring	*Monitoring group effort*: comments about group process and achievements	- *We are almost done; we only need to add a report on the environmental impact of Chernobyl, and it also needs to contain information on pine trees.*
	Reflecting on medium: comments on the effectiveness of the medium for supporting group activities	- *Yes, but I hear some echo. Maybe you can increase the volume of your microphone so we can hear you better.*
Social Interaction	*Off-task comments*: conversation about social matters unrelated to group task; this type of activity may help to 'break the ice'	- *I don't understand how it is possible – to be an environmental scientist but also afraid of insects* - *studying is sometimes nice and fun... but not always...* - *the weather now is +35 C.*

purpose by two environmental science experts: one from each university. In short, students were expected to clearly define the specific niche/focus of their group's research topic and support their research question with arguments that are based on theory or literature and lecture materials. In addition, they needed to demonstrate a feasible approach (i.e. data plus strategy) on how to answer the chosen research question (see Table 4).

Each criterion was scored as follows: 1 point = *criterion not met*; 2 points = *criterion partly met* and 3 points = *criterion met*. Each group's project proposal was immediately assessed following its presentation by a total of four experts, two from each university. The mean score for the 10 criteria was calculated per expert and the mean project score was the mean of the scores from the four experts. A group's project plan was thus assigned a quality score of 1, 2 or 3.

The Cronbach's alpha for the reliability of the coding by the four experts was calculated for the 10 assessment criteria and found to be reasonably good (0.77).

2.6.3. Experiences with CSCL

The so-called critical incident technique (CIT) was used to elicit information on the students' most positive and negative collaborative experiences as well as their use of the IECS and CS within the CSCL environment. In semi-structured interviews, the CIT asks individuals to describe how they behaved in a particular situation and to give reasons for the decisions that they made then (Popov et al., 2014). Students were told that a particular collaborative experience could be considered positive or

Table 4.   Quantitative criteria for assessment of group learning performance.

Criteria		Criteria met (1 point = *criterion not met*; 2 points = *criterion partly met*; and 3 points = *criterion met*)
Development of research question		
1	Clearly defined the specific niche/focus within the group's topic	
2	Research question is specific and answerable	
3	Research question includes elements from lectures and literature provided	
4	Regarding space, research will focus on a specific location, country	
5	Regarding time, research will address a specific event or developments across a year, decade, or century	
6	Good development of the research question shown in arguments that are based on theory or literature and lecture materials	
Development of strategy (data plus approach) to answer research question		
7	Feasible plan to answer the research question	
8	Clearly defined source to provide information to support group's arguments	
9	Clear explanation of how to find additional information needed by the group	
10	Elaboration of questions to ask expert	

negative when the interviewee believed that the CSCL experience or a specific aspect of the experience contributed significantly to the project outcome.

To investigate script adherence and the utility of the IECS and the CS, the students were also asked during the interviews if they had indeed followed the instructions and, if so, just how frequently. They were asked what they found particularily useful in the instructions and what they might do differently if they were given a second chance to collaborate in an otherwise similar situation. The students were instructed to fully answer the interview questions, provide specific examples whenever possible and to take time to think about their responses before stating them.

The first author conducted all of the interviews. At the beginning of each interview, he informed the student that the conversation and their identity would be kept confidential; he also requested permission to record the interview.

The recordings of the interviews were transcribed, and their content further coded using the inductive thematic analytical technique as described by Hayes (2000). Meaningful units in the interviewees' responses to the interview questions were identified, and those selections of text addressing the same meaningful units were then grouped together to identify important categories. All transcripts were coded by two coders to ensure the coherence and replicability of the categories. To assess inter-rater reliability, Cohen's kappa was calculated for each of the emerged categories. For each category, the resulting kappa indicated good or very good agreement between the two coders, ranging from .74 to .88.

2.6.4.   Control information

The Online Technologies Self-Efficacy Scale (OTSES), which has been shown to have good construct validity and internal consistency, was used to assess the technical/computer skills necessary for working with the web conferencing system (Miltiadou & Yu, 2000). In the present study, the Cronbach's alpha reliability coefficient was .79 for the 30-item instrument.

To gain insight into the prior experiences of the students with working together in person, collaborating online and intercultural collaboration, they were asked to rate the extent of their experience along a 5-point scale (1 = *very little*; 5 = *very much*).

The level of the students' prior domain knowledge was assessed by asking which courses they had attended. As the researchers were aware of the contents of the courses, it was possible to assess students' level of relevant domain knowledge at least indirectly. Both the Dutch students and the Ukrainian students followed courses concerned with ecology and the biosphere, and sustainability transitions, but none of the students had previously followed a course directly related to radioactivity and nuclear power.

2.7.   Analyses

Analyses of variance were conducted to compare the control measures for the two conditions. Chi-square tests were used to test whether the distributions of males and females within the two conditions were equivalent.

Due to the small sample sizes per condition, further inferential statistics could not be applied. The descriptive statistics for online collaborative learning behaviour and performance were compared across conditions. In addition, the results of the qualitative content analysis of the interview transcripts revealed several key themes for comparison.

Student online collaborative learning behaviour and performance clustered within groups and were therefore analysed at the level of the group (Stahl, 2010).

3.   Results

3.1.   Control measures

No significant differences were found between the IECS and CS conditions with respect to age, $F(1, 45) = .69$, $p = .41$, computer skills, $F(1, 45) = .29$, $p = .59$ or prior collaboration experience, $F(1, 45) = .36$, $p = .54$. The distribution of males and females was also similar across the two conditions (Chi-square = 2.65, $df = 1$, $p = .13$).

3.2.   Online collaborative behaviour

Table 5 summarises the results of the descriptive statistics for frequencies of collaborative behaviour categories and subcategories according to condition. Specifically, the groups in the IECS condition showed a lower frequency of Initiating Activities and Organising Behaviour than the groups in the CS condition. The groups in the IECS condition also demonstrated a higher frequency of the Feedback Giving, Sharing Knowledge and Explaining than the groups in the CS condition. Lower

Table 5. Means and standard deviations for frequencies of collaborative behaviour categories and subcategories according to condition.

Collaborative behaviour main categories and subcategories	IECS		CS		Total	
	M	SD	M	SD	M	SD
Planning	8.89	7.98	11.13	5.61	9.97	6.50
Group	.08	.16	0.07	.14	.07	.13
Organising Work	6.18	5.25	7.74	2.99	6.96	4.05
Initiating Activities	2.63	2.94	3.32	2.59	2.97	2.59
Contributing	20.24	5.43	11.91	7.05	16.08	7.33
Help Giving	2.41	2.84	2.16	2.39	2.28	2.43
Feedback Giving	6.91	6.06	5.19	3.01	6.05	4.54
Exchanging Resources	.74	.87	.25	.31	.49	.66
Sharing Knowledge	2.46	1.85	1.41	1.96	1.93	1.85
Challenging	1.68	1.84	.49	.43	1.08	1.39
Explaining	6.04	3.44	2.41	2.11	4.22	3.28
Seeking Input	12.06	5.13	14.36	7.32	13.21	5.98
Help Seeking	1.83	1.97	1.16	1.49	1.49	1.66
Feedback Seeking	7.66	1.78	9.11	6.71	8.38	4.61
Advocating Effort	2.57	2.00	4.09	1.66	3.33	1.88
Reflection/Monitoring	3.15	1.12	3.74	.83	3.45	.97
Monitoring Group Effort	.41	.62	.35	.47	.38	.51
Reflecting on Medium	2.74	1.10	3.39	.95	3.07	1.01
Social Interaction	7.42	3.71	9.27	7.72	8.34	5.69

frequencies of Feedback Seeking and Advocating Effort were apparent for the groups in the IECS condition compared with the groups in the CS condition. For the Social Interaction category of collaborative behaviour, the groups in the IECS condition showed a lower frequency of occurrence than the groups in the CS condition (see Table 5).

3.3. *Learning performance*

Higher scores were obtained for the project plans in the IECS condition ($M = 2.55$, $SD = .31$) than in the CS condition ($M = 1.89$, $SD = .22$).

3.4. *Reported CSCL experiences*

In addition to the quantitative analyses, we conducted a qualitative analysis of the interview data to gain insight into the experiences of the students with the use of the IECS versus the CS in a CSCL environment.

The inductive thematic analysis resulted in seven categories. These seven categories largely corresponded to the topic areas in the interview schedule and they were the following: (1) the most successful intercultural CSCL experience, (2) miscommunication, (3) technical problems, (4) level of English proficiency, (5) coordination difficulties, (6) script adherence and the utility of using the IECS or the CS and (7) students' beliefs about strategies for successful collaborative learning.

With regard to the students' opinions and feelings about the – in their opinion – most successful intercultural collaborative work experiences, 16 out of 20 interviewed students reported that they liked the idea of being able to interact at a

distance and learn from international peers with different perspectives on subject matter. They also reported that one of the most successful experiences was the discussion part and working through misunderstandings to create a joint project plan that combines different viewpoints and pieces of information.

With regard to the students' opinions and feelings about the most challenging experiences, out of 20 interviewed students, 12 (i.e. 4 in the IECS condition and 8 in the CS condition) mentioned situations in which the intended meanings of online postings were misinterpreted or could not be understood. The following misunderstanding is illustrative.

> Sometimes what they wrote had a different meaning. For example, to measure the level of radioactivity in some food products, they asked us to bring cucumbers for the second week, 200 grams of dry weight. But a cucumber consists of 96% water. So, we thought we needed to bring like 20 kilograms of cucumbers, which was not possible. But what they actually meant is 200 grams of dry, fresh, in good condition cucumbers; a total of 2 or 3. (Dine, Dutch student from the CS condition)[1]

More than half of the interviewed students expressed technical frustrations concerned with the quality of the video and audio, the time lag between responses from group members, and people speaking at the same time.

Predominantly the students from the Netherlands (3 in the IECS condition and 5 in the CS condition) mentioned that the other members of the group (i.e. the Ukrainian members) provided overly short responses because, in their opinion, the Ukrainian students were not comfortable speaking English.

> A language barrier was an issue for the Ukrainians. Maybe they are afraid of making mistakes when speaking a foreign language. Once I asked one of my Ukrainian teammates if she wanted to add something to the presentation. She replied: '50/50'. She could have said 'Yes' or 'No', but not 50/50; it was confusing for me. (Jack, Dutch student in the IECS condition)

While miscommunication and technical problems were themes raised by almost all of the interviewed students, eight of the students in the CS condition and two in the IECS condition noted coordination difficulties as well:

> Different perceptions of how to deal with the task. It was hard to come to an agreement on who will do what. Also, it took us some time to figure out what is important and what aspect would be interesting to research. (Olga, Ukrainian student in the CS condition)

With regard to script adherence and the utility of using the IECS or the CS for CSCL, four Dutch and three Ukrainian students in the CS condition said that the script was useful because it provided an overview of the collaboration and helped the members of the group agree upon a course of action. A typical response was:

> It was very handy to have a clear understanding the order in which we were going to do things. In the discussion, it was important to make sure that we were on the same level. If we had not had a guideline, it would have been even harder to get on the same level. (Victor, Ukrainian student in the CS condition)

In contrast, one Dutch and two Ukrainian students from the same condition reported that they thought that the CS was unnecessary or that they simply did not follow it because 'in such a short time, you just go your own way to get the things done', 'there are differences in how to work together, you just need to accept those differences' or 'we rushed into the task and skipped several steps from the guideline'.

Out of the 10 interviewed students who participated in the IECS condition, four Dutch and four Ukrainian students reported that the instructions helped them get on with the task and how to approach group members. According to the students, they referred to the script once or twice per collaboration step on average.

> It was very good to have a guideline. I read through the instructions and said I would try. Especially when I was struggling with what to do next, I just looked it up. But I have to say that some people need those instructions more than others. For example, sometimes my Dutch group members asked 'What shall I say, what shall I talk about?' They needed a little bit more guidance than I did. (Kate, Dutch student in the IECS condition)

Two of the 10 interviewed students in the IECS condition reported that they did not follow the instructions for reasons similar to those mentioned for the CS condition.

When asked what they would do differently if given a second chance to collaborate in an otherwise similar situation, the students suggested the following points:

> … after two days of collaboration, students should reflect together with teachers on the group process and provide feedback on how to improve the group process.

> … improve the quality of the video and audio to speed the flow of communication.

> … use Skype as an alternative communication platform because most students are already familiar with this programme, which is not the case for Adobe Connect.

> … make the collaboration longer than a week.

> … make the group smaller in order to increase involvement of all members.

4. Discussion

To evaluate the effects of using an IECS in a CSCL environment, we first examined the students' online collaborative learning behaviour. The students in the IECS condition displayed a higher frequency of Feedback Giving, Sharing Knowledge and Explaining behaviour than the students in the CS condition but a lower frequency of Initiating Activities, Organising Work, Feedback Seeking, Advocating Effort and Social Interaction. These differences can be attributed to specific aspects of the scripts that were used in the two conditions and the IECS instructions in particular. The relatively low frequency of Initiating Activities and Organising Work in the IECS condition can be attributed to the IECS fulfilling a coordinating function. The instructions provided by the IECS reduced the organisational needs of the relevant groups. In keeping with this, the students in the CS groups more frequently sought feedback from the group and had to urge group members to contribute to the group effort more than the students in the IECS groups, which suggests that the groups in the CS condition regularly needed more postings to agree upon a course of action than the groups in the IECS condition.

With regard to the students' online collaborative behaviour during the main collaboration phase of the project planning, the students were instructed to share information and discuss ideas on how to solve the task with their fellow group members. The IECS instructions *explicitly* encouraged the Dutch students to share as much information as they could and also allow group members sufficient time to reflect and respond. The IECS instructions *explicitly* encouraged the Ukrainian students to feel free to disagree with the opinions of group members and be as direct and as

specific as possible when doing this. Together, these IECS instructions elicited a greater circulation of information as reflected by more Feedback Giving, Sharing Knowledge and Explaining behaviour than the instructions in the CS condition. The dyads in the IECS condition showed relatively more 'challenging and explaining' interactions than the dyads in the CS condition. This type of interaction has been shown to be conducive to learning and can provide an indication of greater level of engagement in the collaboration process (Hathorn & Ingram, 2002). Previous research has shown that learning is particularly likely to occur when the collaborating students engage in constructive argumentation (i.e. critique, challenging of positions and attainment of synthesis via discussion) (Cho & Jonassen, 2002).

It should be noted that the students in both conditions had conversations about social matters. This is important for the social cohesion and interactional dynamics of the group (Kreijns et al., 2003). The students in the CS condition showed a greater exchange of utterances for social interaction throughout the collaborative task than the students in the IECS condition. Presumably owing to the social exchanges at the start of the IECS condition, the students in this condition were later more task focused than the students in the CS condtion.

With regard to our second research question about the possible differences in learning performance between the students working in culturally heterogeneous groups using IECS versus CS instructions, the groups in the IECS condition attained higher scores for their project plans than the groups in the CS condition. Previous research on CSCL has shown learning outcomes for a group to depend on the quality of the collaboration in the group (Lipponen, 2002). Compared with the groups in the CS condition, the groups in the IECS condition showed higher levels of Feedback Giving, Sharing Knowledge and Explaining interactions – or the types of interactions that have been shown to be conducive to learning (Andriessen, Baker, & Suthers, 2003). Studies using larger sample sizes and thereby inferential statistics are neverthelss needed to verify this finding.

With regard to the third research question about the CSCL experiences of the students and the usefulness of an interculturally enriched collaboration script, the majority of the Dutch students closely examined the offered script – either the IECS or the CS – while the majority of the Ukrainian students did not do this to the same extent. The Ukrainian students reported repeatedly referring to the script for help with their communication. According to the interviewed Ukrainian students, they mostly consulted two parts of the scripts as most helpful: (1) the general instructions on WHAT to do and (2) the IECS instructions on HOW to perform a particular subtask. The WHY part of the IECS scripts in which the reasons for conducting a particular subtask are explained was reported as uninteresting by most of the interviewed students because the goal of the assignment as a whole was sufficiently clear and the students therefore focused on completion of the assignment. Also, a substantial number of students in both conditions reported the three-step organisation of the collaboration process to be quite helpful: (1) individual work, (2) discussion with group members and (3) discussion and integration of input. This finding is in line with the research of Rummel and Spada (2005), who stated that providing a specified sequence of events for the collaborating students to follow as part of the collaboration script instructions can affect their collaborative learning experiences and effectively improve group dynamics.

As expected, the Dutch students in our study mostly concentrated on the content of the learning process and were more task oriented than the Ukrainian students,

who showed more 'small talk' in order to establish, confirm, maintain and develop group cohesion. In the Ukrainian group of students, there were some with weak English language skills – as indicated by the interviews and chat protocols. Language problems can certainly impede intercultural collaboration and learning outcomes. Also, owing to the uneven English language skills of the Ukrainian students and a more collectivist attitude towards group work among the Ukrainian students than among the Dutch students, the Ukrainian students with weak English language skills would mask their deficiencies by 'saddling' the stronger students in the group with parts of their responsibilities.

5.   Conclusion

In this article, we present the results of an exploratory study of the effectiveness of an interculturally enriched collaboration script relative to a general collaboration script to facilitate and guide the online intercultural interaction process. We examined the students' online collaborative learning behaviour during the study, and both group performance and experiences of the students following the study. The results showed the IECS with instructions specifically tailored to the individualist or collectivist cultural backgrounds of the various students in the collaborative group to promote greater rapport, greater engagement in productive debate and more positive CSCL experiences. We conclude that a well-designed IECS script can facilitate collaboration and help collaborating students bridge culture-related differences.

Additional experimental investigations using larger sample sizes are needed to confirm the present results. Smaller groups of more culturally heterogeneous students or even dyads might also be studied. In the present study, students from only two cultures collaborated in groups of six; generalisation on the basis of the present findings is, thus, limited.

Cultural background proved to be an important factor, as expected, in the present study. Cultural background should nevertheless not be overestimated or treated as an absolute research parameter in light of other research suggesting that individual, personal characteristics can also play a role and sometimes prevail over cultural background during collaborations involving people with different backgrounds (Ting-Toomey, Oetzel, & Yee-Jung, 2001). It is therefore recommended that the contributions of both individual and cultural characteristics to the online collaboration of culturally heterogeneous groups be examined in future research.

It is also recommended that more extended online collaboration be examined in the future. The duration of the present intervention was brief, which means that the effects may have been limited in addition to the period of data collection and observation.

This research indicates how knowledge of intercultural differences and their possible impact on group processes as well as computer-supported collaboration scripts can facilitate informed design of meaningful collaborations for learning and teaching in culturally heterogeneous CSCL groups. The cultural backgrounds of students, for example, provide an indication of what collaborative behaviours can be expected on their part. Collaborative tasks can and should therefore be tailored to the expected interaction process and to help students working in an online learning environment. The present study provides insight for the design of collaboration scripts for use in an online, intercultural environment. For example, social interaction should be fostered via informal introductions and the exchange of personal profiles. Similarly,

critical discussion that includes concrete feedback and sufficient time to reflect should be encouraged. And providing a more or less set sequence of activities for the collaborating students to follow as part of the script instructions can minimise the amount of effort required to coordinate the collaborative learning process. Additional studies using a similar experimental set-up but with larger sample sizes are needed to provide more definitive evidence for both the theoretical and practical aspects of using an IECS to promote intercultural CSCL.

Note

1. Here and in all subsequent interview excerpts, we present the student's alias, cultural background and script condition after the excerpt. All of the interview excerpts are direct quotes.

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