Facilitation of computer-supported collaborative learning in mixed- versus same-culture dyads: Does a collaboration script help?

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Vitaliy Popov [a,*], Harm J.A. Biemans [a], Dine Brinkman [a], Andrei N. Kuznetsov [b], Martin Mulder [a]

[a] *Education and Competence Studies Chair Group, Wageningen University, Hollandseweg 1, 6700 EW Wageningen, The Netherlands*
[b] *Foreign Languages and Culture Studies Chair Group, Academy of Professional Development and Re-Training of Educators, Golovinskoye shosse, bld. 8-2a, 125212 Moscow, Russia*

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ABSTRACT

To foster collaboration and improve the quality of students' discussions in mixed- and same- culture learner groups engaged in computer-supported collaborative learning (CSCL), a collaboration script was introduced. A 2×2-factorial design was used to examine the effects of using this collaboration script on students' online collaborative behavior and the quality of their discussions. A total of 130 university students worked in dyads on a topic concerned with intercultural communication. Culturally mixed dyads working with the script showed a higher frequency of seeking input and social interaction than the students in the other three types of dyads. Same-culture dyads working with the script showed a lower frequency of planning activity than same-culture dyads working without the script. Independent of script condition, the same-culture dyads displayed a higher frequency of contributing activity and showed a higher quality of online discussion than the mixed-culture dyads. Collaboration in culturally mixed groups is less than optimal and may require extra facilitation.

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1. Introduction

Today's information and communication technologies make it possible for schools to: (a) prepare learners for participation in a networked, virtualized society (Belz, 2003; O'Dowd, 2003); (b) form learning communities regardless of physical and temporal barriers (Rovai, 2002); and (c) stimulate both the cognitive and social development of their learners (Weinberger, Ertl, Fischer, & Mandl, 2005). The latter can be done with the aid of online group discussions (Weinberger et al., 2005), reflection on behavior with the help of an online peer feedback and reflection tool (Phielix, Prins, Kirschner, Erkens, & Jaspers, 2011), or the use of cooperation scripts to facilitate web inquiry and online learning (Kollar, Fischer, & Slotta, 2007). Over the past two decades, experimentation with internet usage in education and the adoption of learning management systems have provided insight into the use of online discussion forums to encourage collaborative learning among students (Nandi, Hamilton, Chang, & Balbo, 2012).

Positive effects for computer-supported collaborative learning (CSCL) have been widely documented in particular (see Lehtinen (2003) for a review). In CSCL, the collaboration of two or more learners to solve a problem is supported with not only computer technology but also the provision of an environment that promotes collaboration between students and thereby learning processes (Kreijns, Kirschner, & Jochems, 2003).

In multicultural settings, however, the introduction of CSCL has been found to bring not only benefits but also major challenges. Students can differ not only on how they view a collaborative task but also on how they view their compliance with task requirements, for example. Such matters depend upon students' procedural knowledge (i.e., experiences, feelings, information, strategies, and knowledge related to activities) (Fischer, Kollar, Stegmann, & Wecker, 2013; Kollar, Fischer, & Hesse, 2006; Rummel & Spada, 2005). Group dynamics can also be affected by the composition of the group, the size of the group, the collaborative media being used, and the specific learning task (Dillenbourg, 1999). The cultural composition of the group has also been shown to play a critical role in the functioning and success of a collaborative learning group (Cox, Lobel, & McLeod, 1991; Lim & Liu, 2006).

Same-culture groups share similar socio-behavioral norms, communication styles, and perceptions of the learning environment — which are all likely to encourage the building of effective in-group relationships, social bonds, and efficient communication processes while minimizing anxiety and group conflicts (Lim & Liu, 2006). In contrast, mixed-culture groups often suffer from misunderstandings and coordination difficulties when working on tasks together (Anderson & Hiltz, 2001; Popov et al., 2012; Weinberger, Clark, Hakkinen, Tamura, & Fischer, 2007). Other potentially detrimental factors such as insufficient turn-taking, inadequate time management, little or no distribution of subtasks, reduced social presence, lack of nonverbal cues, and limited

* Corresponding author at: Education and Competence Studies Chair Group, Wageningen University, bode 68, P.O. Box 8130, NL 6700 EW Wageningen, The Netherlands. Tel.: +31 317 48 43 06; fax: +31 317 48 45 73.

E-mail addresses: vitaliy.popov@wur.nl, vitp83@mail.ru (V. Popov), harm.biemans@wur.nl (H.J.A. Biemans), dine.brinkman@wur.nl (D. Brinkman), andremos@inbox.ru (A.N. Kuznetsov), marin.mulder@wur.nl (M. Mulder).

insight into other social cues can then become major stumbling blocks (Chen, Hsu, & Caropreso, 2006; Kim & Bonk, 2002; Uzuner, 2009). Particularly when the collaborating students do not know each other and must work together for the first time, major problems can arise (Janssen, Erkens, Kirschner, & Kanselaar, 2009). As a result, learners working in multicultural groups may not overcome the challenges of CSCL to achieve the potential rewards of such collaboration without additional facilitation.

The use of various kinds of scripts has been found to be very valuable in recent CSCL research (see Fischer et al., 2013 for an overview; Kollar et al., 2006; Weinberger et al., 2005). Scripts have been used to "promote productive interactions by designing the environment such that suggestions of different degrees of coercion are made to the collaborating students, engaging them in specific activities that otherwise might not occur" (Weinberger, 2011 p. 190). While recent research has shown collaboration scripts to effectively support online collaboration, we have little insight into the functioning of such scripts for same- versus mixed-culture groups. In the present study, we therefore explored the effects of a collaboration script when used by same- versus mixed-culture collaborative learning dyads.

2. Theoretical background

2.1. Culture and online collaborative learning

From a social constructivist perspective in which the importance of the personal and cultural backgrounds of learners are recognized as factors that can influence the manner in which they learn and acquire knowledge, we investigated the collaborative learning of same- versus mixed-culture dyads (Vygotsky, 1978; Wertsch, 1998; Zhu, 2009). We adopted Hofstede's definition of culture, namely: "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" (1980, p.25). Within the specific context of online collaborative learning, we thus treated culture as one of the factors that can shape students' perceptions of the collaborative process, communication, and behavior in the group (Cox et al., 1991; Shi, Frederiksen, & Muis, 2013).

Three primary areas of research on the relationship between the cultural backgrounds of students and their learning in an online collaborative learning environment can be distinguished: (1) studies of cultural differences in the perceptions of the online group processes (e.g., Anakwe & Christensen, 1999; Thompson & Ku, 2005); (2) studies of how the linguistic and cultural backgrounds of the collaborative partners affect their actions, behaviors, and engagement in the online collaborative environment (e.g., Kim & Bonk, 2002; Lim & Liu, 2006; Oetzel, 2001); and (3) studies of the differences in the motivation of the students to work within an online collaborative learning environment (Wang, 2007).

Cultural differences can both benefit and disrupt "intra-group dynamics" (Halverson & Tirmizi, 2008, p. 12). Key benefits can be derived from the sharing of culturally diverse knowledge and the preparation of students for working in culturally heterogeneous groups. Likely challenges are the need to coordinate markedly different, culture-specific perceptions of group processes and approaches to communication.

Students from different cultures can also display remarkably different patterns of behavior within their online collaborative interactions. When Kim and Bonk (2002) investigated American, Finnish, and Korean students conducting asynchronous web-based conferences, they found the American and Finnish students to show more task-oriented behavior than the Korean students while the Korean students showed more relationship-oriented behavior than the American and Finnish students. Similarly, Setlock, Fussell, and Neuwirth (2004) found the communication strategies employed by Asians (i.e., individuals from India and East Asia) versus Westerners (i.e., individuals from North America) to differ in terms of argumentation. The Westerners

tended to focus on mostly points of disagreement while the Asians tended to discuss each point regardless of whether there was disagreement on the point or not.

In other research, Wresch, Arbaugh, and Rebstock (2005) analyzed the patterns of participation in discussions by American and German university students collaborating together in an interactive online learning environment. The German students showed lower levels of participation relative to the American students. More importantly, the differences in participation could be traced to differences in the perceptions and expectations of the students with regard to the international online course. In the U.S.A., teachers are involved in the learning process, continually steer the efforts of student, and therefore have considerable interaction with students. In Germany, regular interaction with teachers or, for that matter, other students is the exception than the rule. This means that — although only incidental or virtually nonexistent — the participation of the German students in the online class was consistent with their usual learning behavior.

In still other research, Tapanes, Smith, and White (2009) showed differences in student perceptions of an online course at two American universities to reflect the individualist versus collectivist cultural backgrounds of the students: students with a collectivist cultural background were less motivated to participate in an asynchronous learning network (i.e., networks for anytime and anywhere learning via computer communications technologies, Hiltz & Goldman, 2005) than students with an individualist cultural background. The individualist–collectivist cultural orientation as put forth by Hofstede (1991) has been widely used to describe what appear to be culturally-based differences in collaborative group processes, including online learning environments (e.g., Cox et al., 1991; Goncale & Staw, 2006; Oetzel, 2001).

In a number of studies, the following aspects of communication have been reported to pose problems for culturally diverse students collaborating online: (1) inability to understand specific cultural references in online discussions; (2) lack of non-linguistic cues; (3) difficulties expressing disagreement; (4) communicative constraints resulting in less substantive postings; and (5) mismatched communication patterns (i.e., use of short, content-driven contributions as opposed to long, relationship-driven contributions or vice versa) (see Uzuner, 2009 for a review).

Early studies of the quality of collaborative learning primarily examined individual learning outcomes and final group results. They therefore failed to recognize that most collaborative learning outcomes are mediated by the quality of the group discussion and dynamics (Lim & Liu, 2006). We now know that assessment of the quality of online discussions is crucial for the successful use of technological learning environments (Hawkes & Dennis, 2003). This assessment can be done with regard to the content of the discussion and thus in terms of adequate clarification, justification, elaboration, and application of theories and other information related to the subject matter and discipline. Assessment can be done with regard to participation in the discussion and thus in terms of the consistency and frequency of the students' involvement (Henri, 1992; Nandi, Chang, & Balbo, 2009). In assessing the quality of the online interactions, cultural factors that are known to play a role in what students share, expand upon, and gain from a collaborative learning process should also be considered (e.g., Kim & Bonk, 2002; Zhao & McDougall, 2008; Zhu, 2009). However, many social and cultural factors have yet to be taken into account in the study of online collaborative learning (Cox et al., 1991; Vatrapu & Suthers, 2010; Weinberger et al., 2007). Very little research has empirically examined the quality of online discussions involving students with different cultural backgrounds (exceptions are Shi et al., 2013; Vatrapu, 2008; Zhu, Valcke, Schellens, & Li, 2009).

In sum, CSCL offers students opportunities to connect across time and space, but its successful application is hard to achieve due to not only the limitations imposed by working in an online environment but also the challenges of online collaboration and learning. Critical

factors are the manner in which the collaborative technology gets implemented and the instructional approaches used to guide the online collaboration. In the case of cross-cultural collaboration, additional support may be required to overcome the extra layer of complexity created by the different cultural backgrounds of the collaborators.

2.2. Use of collaboration scripts to support online collaboration

Several instructional approaches have been developed over the past twenty years to provide support for peer interaction within a CSCL environment (e.g., Dillenbourg & Jermann, 2007; Jeong & Joung, 2007; Kollar et al., 2007; Rummel & Spada, 2005). Little effort has been made to facilitate the interaction between culturally diverse students working within a CSCL environment, however. In the few studies that have done this, moreover, the focus has been largely on: intercultural foreign language education (Thorne, 2006), raising intercultural awareness (Elola & Oskoz, 2009), and the use of e-tools to promote cultural diversity for purposes of brainstorming and considering alternative perspectives (Wang & Fussell, 2010). Knowledge is thus still lacking of what other instructional support is needed to help culturally diverse learners benefit maximally from a collaborative learning experience (i.e., the sharing of experiences and co-construction of knowledge within a CSCL environment).

The use of collaboration scripts to facilitate CSCL has been found to be promising in general (see Fischer et al., 2013, for an overview; Weinberger et al., 2005; Kollar et al., 2006). Collaboration scripts can be used to scaffold what students need to do during a collaborative task, the roles to be played, and the sequence of activities to be performed (Carmien, Kollar, Fischer, & Fischer, 2007). Collaboration scripts can also be used to stimulate those types of interactions that are known to benefit collaborative task performance (Kolodner, 2007).

A collaboration script can be introduced either directly via explicit instruction (e.g., oral presentation, distribution as a handout) or indirectly via embedding in the learning environment (e.g., as a graphic representation or as a set of hints, prompts, cues). Students, for example, may need to evaluate or rank the possible solutions identified for a problem but may not know how to proceed with this; a collaboration script can provide a guideline for performing this step, present a suitable strategy, or do possibly both (Rummel & Spada, 2005). Similarly, a collaboration script can scaffold the interaction between students not only by providing prompts but also by encouraging students to adopt different roles at times; the individual student can be asked to serve as presenter for the group on one occasion and a reviewer on another occasion (see, for an overview, Weinberger et al., 2005).

Collaborative learning in same-culture learner groups can be expected to be easier than in mixed-culture groups. This is due to the generally shared values, norms, and customs of same-culture groups and thus the fewer chances of misunderstanding in same- as opposed to mixed-culture groups. However, the anonymity, reduced social presence, absence of many nonverbal cues, and lack of other social context cues within a CSCL environment can impede mutual understanding, the exchange of information, and — in the end — successful collaborative learning (Jarvenpaa & Leidner, 1998). A collaboration script to help students get "on the same page," agree on a particular course of action, and reach a shared understanding may thus be a welcome addition for the conduct of both same- and mixed-culture collaborative activities.

Back in 2001, Curtis and Lawson developed a coding scheme to analyze the behaviors of students involved in collaborative learning activities. Developed to describe the collaboration in an asynchronous discussion forum offered through the Blackboard learning system (i.e., the Discussion Board of the Blackboard used in the present research as well), the coding scheme has also been used in cross-cultural research (e.g., Kim & Bonk, 2002; Swigger, Hoyt, Serçe, Victor, & Alpaslan, 2012). The coding scheme encompasses five categories of behavior previously identified by Johnson and Johnson (1996) as prerequisites for successful face-to-face collaborative learning: (1) planning (e.g., organization of work, initiation of activities), (2) contributing (e.g., explanation of positions, sharing of knowledge), (3) seeking input (e.g., urging others to contribute, seeking for feedback), (4) reflection on medium and monitoring of group processes and achievements (e.g., comments on technological aspects of media, comments on group's progress), and (5) social interaction (e.g., off-task discussion, socializing). Each of the five coding categories concerns a specific collaborative behavior (i.e., social, cognitive, or coordinating behaviors) and all of the categories are necessary for successful online group collaboration (Kim & Bonk, 2002). Furthermore, a search of the relevant research literature showed the coding scheme of Curtis and Lawson to be widely cited, both reliable and valid, and useful for gaining insight into online collaborative learning processes.

2.3. The present study

The present study was undertaken to gain insight into the facilitative effects of using a collaboration script with same- versus mixed-culture dyads working in a CSCL environment. A collaboration script was developed on the basis of the coding scheme of Curtis and Lawson (2001). Same- versus mixed-culture dyads were randomly assigned to one of two conditions (i.e., a condition using versus not using the collaboration script). The dyads were asked to jointly discuss materials concerned with intercultural communication. The quality of their CSCL was then evaluated in terms of online collaborative behaviors and the nature of the group discussion. In doing this, we addressed the following two research questions:

RQ1 Do group composition (same- versus mixed-culture dyads) and the use of a specially designed collaboration script (with vs. without) affect students' online collaborative behavior in a computer-supported collaborative learning environment?

RQ2 Do group composition (same- versus mixed-culture dyads) and the use of a specially designed collaboration script (with vs. without) affect the quality of the students' discussions in a computer-supported collaborative learning environment?

3. Methods

3.1. Participants

Participants were 130 students enrolled in various Master's programs at a university in the Netherlands during study years 2009–2010 and 2010–2011. There were 81 Dutch and 49 international students; 53% of which were women. Of the international students, 19 were from Europe (but not the Netherlands), 5 from Africa, 19 from Asia, 2 from South America, and 4 from North America. A total of 27 countries were represented in the study. The age of the respondents ranged from 20 to 43 years, with a mean of 24 years ($SD = 2.9$); 96.9% of the students were under the age of 30. Before participating in the study, the international students had been living in the Netherlands for an average of 8 to 12 months. All of the students — regardless of cultural background — had at least some short-term travel experience, which could include internships or travel outside the home country for other academic purposes (e.g., study visits, vacation, work). All of the study participants had previously demonstrated their English language proficiency to enroll at the university where the students also interacted with the study personnel and each other in English.

3.2. Study design

A 2×2-factorial research design was used. The independent variables were collaboration script (with vs. without) and group composition (same- vs. mixed-culture). The dependent variables were the students' online collaborative behavior and the quality

of their online discussions. The cultural backgrounds of the students were first determined by asking them to indicate their country of origin at the beginning of the academic year. The students were then randomly assigned to a same- or mixed-culture dyad based on their cultural backgrounds. The dyads thus have either two students from the same country (in this case, the Netherlands) or two students coming from different countries (in this case, mostly one Dutch student with one international student; only 12 dyads were composed of both international students). This resulted in 29 same-culture (Dutch only) and 36 mixed-culture dyads. The students in each dyad did not know each other beforehand.

Next the dyads were randomly assigned to one of the collaboration script conditions. In doing this, we checked to see that each condition had about the same number of same- versus mixed-culture dyads. An overview of the composition of the groups is presented in Table 1.

3.3. Discussion assignment and CSCL procedure

The assignment used in this study was part of an ongoing Intercultural Communication Skills (ICS) course. The aim of the course was to introduce the fundamental principles and issues of intercultural communication. Students participated in the present study as part of the regular study program, which meant that they had all the prerequisite knowledge and skills needed to undertake the learning task.

The task presented to the participants was to conduct an online discussion of the following proposition: "Nowadays, multicultural and globally dispersed teams are becoming the norm in both academic life and the business world. Multicultural teams are always more creative and effective than mono-cultural teams." The proposition was intentionally left open to interpretation in order to call for clarification and prompt discussion.

To conduct the task and complete the assignment, the students were asked to analyze and discuss the proposition via the exchange of online messages with their dyad partner. This was done in a threaded discussion on the Discussion Board of the university's Blackboard. The students were told that they had four weeks to complete the assignment; that they needed to be as responsive as possible within this time frame; that their contributions to the online discussion would be assessed; and that the assessment of the assignment would contribute to whether they passed or failed the course.

Upon completion of the task, the students were expected to be able to: (a) expand their exploration and understanding of the topic; (b) apply the knowledge acquired of intercultural communication theories; and (c) actively participate in an online working group.

The CSCL procedure consisted of two stages. In the first stage, all of the students followed an introductory session in which the collaborative learning task was explained and the Discussion Board within the Blackboard learning environment was introduced. In the collaboration script condition, the paper-based collaboration script was also introduced (see Table 2). The instructions for the discussion of the proposition presented to the students in all of the groups were as follows. (a) Use any available sources and relevant information including the

Table 1
Design of the empirical study.

		Group composition	
		Same-culture (Dutch only)	Mixed-culture
Collaboration script	with	N = 15 dyads	N = 17 dyads[*]
	without	N = 14 dyads	N = 19 dyads[**]

[*] Mixed-culture with the collaboration script: 12 dyads with one Dutch and one international student, and 5 dyads with both international students.

[**] Mixed-culture without the collaboration script: 11 dyads with one Dutch and one international student, and 8 dyads with both international students.

internet, posters, videos, and specialized journals for your discussion. (b) Look at information from alternative points of view in order to consider and possibly develop alternative perspectives on the problem at hand. (c) Assume different roles in the discussion at times (i.e., act "in favor" or "against" the proposition that has been presented). This was done in order to stimulate discussion and avoid simple agreement with the proposition, which meant that the standpoints assumed by the students did not always coincide with their personal opinions. (d) Use only the online Discussion Board to discuss the proposition and avoid any face-to-face discussion. This was done to ensure purity of the intervention and the validity of the CSCL experiment. Following the introduction of the task, the students were also asked to complete a questionnaire that provided us with demographic background information and information on some control variables (e.g., age, gender, computer skills, prior online collaboration experiences).

In the second stage of the CSCL procedure, the researchers formed dyads of students in such a manner that same- versus mixed-culture groups of students were created thus the conditions required for the study (see Table 1). Upon completion of the assignment, use of the collaboration script was checked via administration of a short questionnaire; all students in the experimental condition reported trying to use the collaboration script as much as possible.

3.4. Online learning environment

The Blackboard Discussion Board allows users to communicate with each other via the posting of online messages in an asynchronous electronic format. All of the conversations/discussions on Discussion Board are recorded and saved chronologically (see Fig. 1). When a conversation/discussion is initiated, it is organized as a "thread," which includes the main posting and all related replies. Each dyad has its own electronic space for discussion on the Discussion Board. The students accessed their unique virtual discussion space using a password. They could then read the posts from their partner and post replies.

3.5. Design and use of a collaboration script

All of the students in the two conditions discussed the same proposition, the only difference between the two conditions was the use of the collaboration script in the experimental condition.

The collaboration script (see Table 2) addressed several elements that deemed necessary not only for joint problem-solving (i.e., planning, contributing, seeking input, reflection/monitoring, and social interaction) but also for communication strategies for the students to call upon during the collaboration. The communication strategies included discussion strategies, interaction prompts, and sentence openers that followed culturally-neutral rules of net etiquette as recommended by Shapiro and Anderson (1985). When sending messages: "create single-subject messages whenever possible" and "have in mind a model of your intended audience." When receiving and responding to messages: "try to separate opinion from non-opinion while reading a message, so you can respond appropriately"; "avoid responding while emotional"; "assume honesty and competence on the part of the sender"; and "avoid irrelevancies."

The students were encouraged to refer to the communication strategies whenever they experienced problems getting their message across. One of the reasons for giving the students communication strategies to refer to was that many of the problems that can occur in online discussions between culturally diverse students concern communication. In the following, the five elements judged to be necessary for joint problem-solving are discussed in greater detail.

Planning (1) subsumes three categories of activity related to the organization of work, initiation of activities, and establishment of the dyad/group. When group members fail to coordinate their joint activities or establish good working relationships within the group,

Table 2
External collaboration script.

Steps of collaboration process	Substeps of collaboration process	Examples of communication strategies
Planning	*Establishing group*: encouraging group collaboration and cohesiveness. If you wish to establish a good working relationship with your collaborative partner.	*I know you must be under a lot of stress due to work load. I'll do my best to help.*
	Organizing work: creating shared tasks and deadlines. If you wish to make suggestions to organize group work.	*Due to time constraints, I would like to set a timeline for our collaboration… I think it might be good idea to start with…*
	Initiating activities: scheduling activities to discuss progress and organization of group work. If you wish to initiate activities regarding the task.	*It seems to me that we could present our positions first and then respond to each other's ideas…. I suppose we could do a literature search first.*
Contributing	*Help giving*: responding to questions and requests from others. If you wish to respond to requests or help your collaborative partner understand the assignment or technical issues.	*Yes, we can use any available sources of information including internet, scientific papers, videos. If you want to create a new thread in the Discussion Board, you need to …*
	Feedback giving: reflecting on partner's contributions and providing feedback on partner's proposals. If you wish to give feedback, agree with his/her contributions or state that you have a different perspective.	*Well, you have a point there, but… I see what you mean, but… I'm afraid I can't agree with you on that, because…*
	Exchanging resources: sharing of resources and information to assist each other in a collaborative group. If you wish to exchange some information, articles, videos, books.	*Could you please provide more information about…? The information provided in this article supports my point, because it explains… Could you please help me find the source that you posted?*
	Sharing knowledge: sharing existing knowledge and information. If you wish to share some knowledge with a collaborative group member.	*Both theory and experience show… Data prove…Based on the article…*
	Explaining or elaborating: supporting one's position. If you want to extend your opinion/argument or emphasize your point of view.	*To support my idea, I would like to refer to…* *The key problem with this explanation is that… A possible explanation for some of these results may be…*
	Challenge: challenging the contributions of collaborative partner(s) and seeking to engage in debate. If you wish to provide a critical assessment of a contribution or object to a statement.	*This is not convincing, because…. I find it hard to believe… I doubt if it is possible…* *One of the limitations with this explanation is that it does not explain why… However, such explanations tend to overlook the fact that..*
Seeking input	*Feedback seeking*: seeking feedback to a position advanced. If you wish to receive feedback or ask questions in order to clarify or specify something.	*I look forward to hearing your feedback… We have not reached consensus on these aspects… I hope to hear from you soon… Regarding our difference of opinion…*
	Advocating efforts: urging a collaborative partner to contribute to the group effort. If you wish to ask/urge your collaborative partner to contribute to a group discussion.	*Haven't heard from you for a while… What are your views on this? Due to time constraints, I would like to receive your feedback on…*
	Help seeking: asking assistance from a collaborative partner. If you wish to ask for help with — for example — understanding of an assignment or technical issues.	*Could you please help me find the paper that you referred to in your last post?*
Reflection/monitoring	*Reflecting on medium*: comments about the effectiveness of the medium for supporting activities of the group. If you wish to comment about your experiences with the Discussion Board.	*The program seems to work okay for me… It is easy to navigate….*
	Monitoring group effort: comments about the group's process and achievements. If you wish to reflect on the group process.	*We have not reached consensus on these aspects… I think this is the best short-term solution… We still have time to write a good summary….*
Social interaction: maintaining the group cohesiveness	*Strengthening of relationship in a group*: expressions that encourage group activity and cohesiveness. If you wish to talk about social matters, this activity helps "break the ice."	*I should not be so pushy, I know you are doing the best that you can… I could not reply to you sooner because…* *My weekend was great… I did my Bachelor degree in… If there is anything you don't understand or need help, feel free to ask.*

they will essentially experience difficulties with mutual understanding and process losses, the result of which will be poor learning experiences (Lim & Liu, 2006). It is therefore important that students be given support for not only the planning of activities (e.g., distribution of tasks, organization of work) but also the development of the group during the initial stages of the collaboration.

Contributing (2) encompasses activities such as exchanging resources, giving help, providing feedback, explaining each other's positions, sharing knowledge, and challenging each other's positions. Group collaboration presumably provides collaborative partners with opportunities to engage more deeply and actively in the learning process (Davis, 1993). However, successful collaboration can be constrained by a lack of high-level collaboration processes in which students negotiate meaning and narrow gaps in their opinions. It is therefore important that students be given support on how to best present their ideas, ask for feedback or clarification, explain one's point of view, and provide extra resources. If students know how to act in a collaborative learning situation, know what linguistic forms to use to express their arguments, and know what they can expect from their collaborative partners, then they can maximally benefit from the sharing of knowledge and conduct a high quality discourse (Weinberger et al., 2007).

Seeking input (3) includes urging others to contribute to the group effort, eliciting comments on the ongoing group process, and gathering feedback on group achievement/progress. The absence of nonverbal cues and social context cues during online discussion can hamper reciprocal understanding and the exchange of information (Walther, 1997). The provision of a collaboration script is therefore aimed to foster good communication and an adequate flow of information within the collaborative group.

Reflection/monitoring (4) concerns not only the media being used but also the ongoing group process and progress. Discussion of the work situation is important to identify the preferences of the collaborative partners (Curtis & Lawson, 2001).
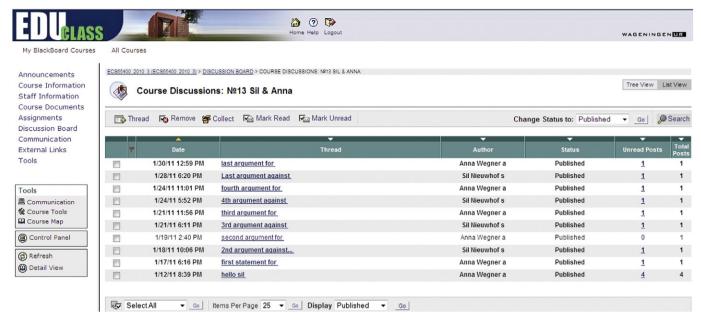
Fig. 1. Screenshot of online interaction using Discussion Board.

Social interaction (5) covers off-task comments and discussions that can nevertheless serve to strengthen the relationships within the group, encourage group activity, and maintain group cohesion. Conversations concerned with social matters can be particularly important for online collaboration due to the otherwise loosely bound nature of the group (Lim & Liu, 2006; Morse, 2003). According to Curtis and Lawson (2001), online courses should be designed to encourage more social interactions, because a lack of familiarity among group members may constrain successful collaboration.

3.6. Measures and sources of data

Table 3 presents an overview of the independent, dependent, and control variables used in this study. The relevant categories of data and how the data were collected are also summarized in this table. The specific variables and just how they were measured are described in relation to the two research questions below.

3.6.1. Measures of online collaborative behavior (RQ1)

In the present study, the framework of Curtis and Lawson (2001) was used as both an intervention and assessment tool. The framework supplied the foundation for the design of the collaboration script and it was also used to analyze the occurrence of collaborative behavior in the transcripts of the students' online discussions (i.e., to measure the effects of the collaboration script on the online behavior of the students). Other studies have similarly used this coding scheme to analyze the behavior of students engaged in online collaborative learning, examine their contributions to a Blackboard Discussion Board, and perform cross-cultural comparisons (Curtis & Lawson, 2001; Kim & Bonk, 2002; Swigger et al., 2012).

Prior to the coding of the data, the two coders discussed and reached consensus on the definition of each coding category and the coding subcategories. This was done on the basis of the descriptions and examples presented in Curtis and Lawson (2001). Each chat protocol was then coded by the two coders.

The online contributions (i.e., "utterances") of the students were examined for collaborative behaviors falling into the five categories of planning, contributing, seeking input, reflection/monitoring, and social

interaction. The occurrence of a number of subcategories was also assessed (see Table 2 for examples of the subcategories). Pilot testing of the coding scheme showed it to be clearly applicable. Each utterance consisting of mainly phrases and sentences posted by the student and reflecting a specific collaborative behavior was coded. The coding subcategories were mutually exclusive (i.e., only one coding subcategory could be assigned to an utterance). Salutatory and closing utterances were ignored in the coding of the data.

The inter-rater agreement between the two trained coders (Cohen's k = 0.76) (Landis & Koch, 1977) and the intra-coder test–retest reliability for each of the coders were calculated for 10% of the data (85% identical codes). Both were found to be sufficiently high.

The dependent variables in the subsequent analyses were the absolute total scores for each category of behavior and its respective subcategories for each dyad.

3.6.2. Measures of discussion quality (RQ2)

To analyze the quality of the students' online discussions, a qualitative content analysis of the transcripts was conducted using a coding scheme that drew upon two existing coding schemes (Clark & Sampson, 2008; Noroozi, Biemans, Busstra, Mulder, & Chizari, 2011). The existing coding schemes have been used to analyze online discourses in the past and shown to meet the criteria of completeness, clarity, accuracy, objectivity, reliability, and validity.

We initially evaluated the applicability of the coding categories developed by Noroozi et al. (2011) to the contributions directly related to the content of the task for a subsample of 10 discussion transcripts in the present study. Only three of the five categories from this scheme were judged to be of use for determining the quality of the students' discussions within the context of our study: justification and reasoning, breadth of discussion, and depth of discussion. We did not code the online discussions in terms of the original Noroozi et al. categories of relevance or correctness because it proved difficult, if not impossible, to evaluate the degree of relevance and the accuracy of the contributions occurring as part of an open-ended discussion (i.e., the assignment in the present study).

When the coding of the discussion transcripts for justification and reasoning drawing upon just the system of Noroozi et al. (2011) proved difficult, it was decided to draw upon the coding system of Clark and

Table 3
Independent, dependent, and control variables.

	Variables	Categories	Instruments	Data source
Control variables	Age, gender, computer skills, and prior online collaboration experiences	N/A	Self-made questionnaire developed for this study on the demographic information, computer skills, prior online collaboration experiences	Questionnaire
Dependent variables	Quality of students' discussions in CSCL environment	Breadth of discussion; depth of discussion; justification and reasoning (quality levels)	Qualitative content analysis of chat protocols, based on Noroozi et al. (2011), and coding of chat protocols using Clark and Sampson's framework (2008)	Chat protocols
	Students' online collaborative behavior in CSCL environment	Planning; contributing; seeking input; reflection/monitoring; social interaction	Coding of chat protocols using Curtis and Lawson's scheme (2001)	Chat protocols
Independent variables	Cultural group composition	Same- vs. mixed-culture dyads	N/A	Student report of country of origin
	Collaboration script	Collaboration with vs. without collaboration script	Based on Curtis and Lawson (2001)	N/A

Sampson (2008) as well. This was done to analyze the structure of the dialogic argumentation for the same subsample of 10 discussion transcripts. In their work, Clark and Sampson present a flowchart for coding the grounds (i.e., use of evidence) for individual comments (see below in this section for more detailed description of this coding scheme). All of the postings from the subsample of 10 discussion transcripts were first classified as being part of one of three possible types of units: a task coordination unit (i.e., contributions regarding planning of joint work, distribution of tasks, division of roles); a task content-oriented unit (i.e., contributions directly related to the content of the task and thus the discussion within the context of the present study); or a non-task related unit (i.e., all posts that were social — including salutatory and closing posts — or concerned with technical aspects of the collaboration). Following Veldhuis-Diermanse (2002), a content-oriented unit was further defined as a unit that represents "an idea, argument chain or discussion topic" (p. 46). Following both Clark and Sampson (2008) and Noroozi et al. (2011), it was then decided to only code the content-oriented units further as only these types of units were perceived to be of relevance for evaluating the quality of the students' discussions.

Two coders found task content-oriented units to be clearly evident in the subsample of 10 discussion transcripts and clearly distinguishable from the other two types of units (i.e., task coordination units and non-task related units). Complete agreement was found between the two coders on the identification and subsequent classification of the task content-oriented units. It was therefore decided to have only one coder to select the task content-oriented units for further coding from the remainder of the discussion transcripts.

In the end, a total of 553 content-oriented units were coded: 121 for same-culture dyads using a collaboration script; 124 for same-culture dyads not using a collaboration script; 140 for mixed-culture dyads using a collaboration script; and 168 for mixed-culture dyads not using a collaboration script. All of the content-oriented units were coded for (1) justification and reasoning, (2) breadth of discussion, and (3) depth of discussion. The inter-rater agreement between the two trained coders (Cohen's k = .82) and intra-coder test–retest reliability for each of the coders for 10% of the data (86% identical scores) were calculated. Both were found to be sufficiently high. The three assessment criteria are further described below.

Justification and reasoning are the degree to which arguments are supported and motivated by examples, evidence, or some other form of proof related to essential aspects of the topic being discussed. Within the framework developed by Clark and Sampson (2008), each comment or — in our case — content-oriented unit can be coded as offering no grounds (quality level = 0) (i.e., a content-oriented unit does not include any attempt to justify the position of the poster), offering only an assertion without evidence (quality level = 1), offering only evidence that is not backed by reasons for it (quality level = 2) (i.e., a content-oriented unit that includes a reference to a source of information such

as a personal experience, a reference book, or an example of a situation suggesting that the assertion is correct), or offering multiple sources of evidence with specific interpretation of the data (quality level = 3).

To obtain a mean score for the justification and reasoning quality criterion per dyad, the ratings of the content-oriented messages were summed for each dyad. A content-oriented unit with a quality level of 0 was assigned a score of 1; a content-unit with a quality level of 1 was assigned a score of 2, and so forth. The scores for each level of quality were then summed per dyad and divided by the total number of content-oriented units for that dyad to produce a mean quality score for justification and reasoning in the student discussions for each dyad.

Breadth of discussion is the degree to which substantial elements of clear relevance to the discussion topic are broadly discussed and elaborated upon. The coding of the content-oriented units for "justification and reasoning" was used to determine the breadth of the dyad's discussion as follows. Inadequate breadth was judged to be less than three content-oriented discussion units assigned a score of 2 for providing evidence of arguments (breadth score = 1). Partly adequate breadth was judged to be three or four content-oriented discussion units assigned a score of 2 for providing evidence of arguments (breadth score = 2). Adequate breadth was judged to be five or more content-oriented discussion units assigned a score of 2 or 3 for providing evidence of arguments (breadth score = 3).

Depth of discussion is the degree to which theories and more detailed information related to essential aspects of the discussion topic are presented. A score of 1 to 3 could be obtained for the depth of discussion per dyad. This was determined by counting all of the examples drawn from personal experiences or literature sources for all of a dyad's content-oriented discussion units. Superficial depth of discussion meant that the discussion topic was not elaborated upon to a significant extent and thus had zero to three examples drawn from personal experiences and/or literature sources (depth score = 1). Simple depth of discussion meant that the discussion topic was elaborated upon but only with simple explanation or interpretation and thus had four to six examples (depth score = 2). Elaborate depth of discussion meant that the discussion topic was sufficiently elaborated upon with detailed and clearly developed explanations; there were more than six examples drawn from personal experiences and/or literature sources (depth score = 3).

3.6.3. Control measures

Prior to the actual conduct of the study, a questionnaire was administered to all of the students to obtain information on age, gender, country of origin, and other demographic information. The students were also asked to rate the amount of experience with online group work along a five-point scale (1 = "hardly any"; 5 = "very much"). In addition, to assess the students' mastery of the computer skills necessary to work with the Blackboard Discussion Board, they were presented five multiple-choice questions concerned with the use of "internet web

Table 4
Mean online collaborative behavior according to cultural composition of group and use of collaboration script.

Group composition	Category of behavior	Collaboration script					
		With script		Without script		Total	
		Mean	SD	Mean	SD	Mean	SD
Mixed culture	**Planning**	3.00	1.79	2.68	1.57	2.83	1.66
	Establishing group	.07	.26	.12	.34	.10	.31
	Organizing work	1.64	1.27	1.31	.70	1.46	1.00
	Initiating activities	1.28	.91	1.25	.85	1.26	.86
	Contributing	15.35	5.75	12.87	3.24	14.03	4.67
	Help giving	.14	.36	.18	.40	.16	.38
	Feedback giving	5.58	2.65	4.31	1.49	4.90	2.17
	Exchanging resources	.21	.42	.12	.34	.16	.38
	Sharing knowledge	2.00	.39	1.68	.60	1.83	.53
	Challenging	.78	.57	.43	.51	.60	.56
	Explaining	6.64	2.84	6.12	1.66	6.36	2.26
	Seeking input	4.47	2.52	1.93	1.18	3.23	2.35
	Help seeking	.14	.36	.00	.00	.06	.25
	Feedback seeking	3.92	1.73	1.50	.81	2.63	1.79
	Advocating effort	.64	.63	.43	.62	.53	.62
	Reflecting/monitoring	1.36	1.33	.93	1.18	1.13	1.25
	Monitoring group effort	.86	.77	.81	1.04	.83	.91
	Reflecting on medium	.50	.75	.13	.34	.30	.59
	Social interaction	1.92	2.05	.50	.89	1.16	1.68
Same culture	**Planning**	1.66	1.04	3.78	.97	2.68	1.46
	Establishing group	.00	.00	.28	.46	.13	.35
	Organizing work	1.00	.84	2.03	.67	1.48	.91
	Initiating activities	.66	.48	1.5	.51	1.06	.65
	Contributing	14.80	7.27	16.21	6.22	15.48	6.70
	Help giving	.26	.45	.43	.64	.34	.55
	Feedback giving	4.26	3.23	5.07	2.73	4.65	2.97
	Exchanging resources	.13	.35	.28	.61	.20	.49
	Sharing knowledge	2.06	1.03	2.14	.77	2.10	.90
	Challenging	.46	.83	.35	.49	.41	.68
	Explaining	7.60	2.79	7.92	2.97	7.75	2.83
	Seeking input	2.20	2.42	2.35	2.40	2.27	2.37
	Help seeking	.13	.35	.07	.26	.10	.31
	Feedback seeking	1.60	2.22	1.71	1.63	1.65	1.93
	Advocating effort	.46	.51	.57	.75	.51	.63
	Reflecting/monitoring	1.26	1.94	1.00	1.10	1.14	1.57
	Monitoring group effort	.87	1.24	.79	.80	.83	1.03
	Reflecting on medium	.40	.73	.21	.42	.31	.60
	Social interaction	.60	1.12	.71	1.13	.65	1.11

browsers," MS Word (i.e., a word processing program), MS Excel (i.e., database program), and other programs used for online communication via discussion boards, email, and chat applications.

3.7. Analyses

Analyses of variance were conducted to compare the control measures for the two conditions (i.e., the condition using versus not using a collaboration script). Chi-square tests were used to compare the patterns of results for the males versus females within the different groups of students.

The online collaborative behaviors of the students and the quality of their online discussions were analyzed at the level of the dyad. As the data were clustered within dyads (i.e., the individual scores within a dyad did not constitute independent observations due to collaboration; Stahl, 2010), the combined individual scores for the dyad were used in the analyses.

To answer our first research question (RQ1), we conducted two-way multivariate analyses of variance (MANOVAs) with collaboration script (with vs. without) and group composition (same- vs. mixed-culture dyads) as the independent variables and the mean frequency scores per dyad for the five categories of collaborative behavior and their respective subcategories as the dependent variables (planning, contributing, seeking input, reflection/monitoring, and social interaction). Follow-up univariate analyses of variance (ANOVAs) were conducted

when the MANOVA results showed a significant interaction between the independent variables (i.e., collaboration script condition with same- vs. mixed-culture condition).

To answer our second research question (RQ2), a two-way MANOVA was conducted with collaboration script (with vs. without) and group composition (same- vs. mixed-culture dyads) as the independent variables and the mean quality scores per dyad for the three aspects of the quality of the online discussion as the dependent variables (justification and reasoning, breadth of discussion, and depth of discussion). Follow-up ANOVAs were conducted only when the MANOVA results showed a significant interaction between the independent variables.

4. Results

4.1. Analysis of control measures in two conditions

No significant differences were found when separate ANOVAs were conducted for the control variables of age, computer skills, and experience with online group work: age, $F(3, 126) = 2.3$, $p = .08$; computer skills, $F(3, 126) = .24$, $p = .87$; and prior experience with online group work, $F(3, 126) = 1.5$, $p = .22$. This means that the scores of the students in the collaboration script and group composition subgroups did not differ significantly with regard to age, computer skills, or experience with online group work.

The distribution of males and females within the four subgroups of students also did not differ significantly for the subgroups of students (Chi-square $= .763$, $df = 3$, $p = .85$).

4.2. Online collaborative behavior (RQ1)

For the frequency of utterances reflecting the planning category of collaborative behavior (i.e., the subcategories group, organizing work, initiating activity), a significant interaction between script condition and group composition was found, *Wilks' Lambda*, $\lambda = .84$, $F(3, 59) = 3.52$, $p < .05$, $\eta^2 = .15$. In addition, a significant main effect of script condition was found (*Wilks' Lambda*, $\lambda = .87$, $F(3, 59) = 2.96$, $p < .05$, $\eta^2 = .13$) but no significant main effect of group composition (*Wilks' Lambda*, $\lambda = .97$, $F(3, 59) = .83$, $p = .48$, $\eta^2 = .04$). Post hoc Scheffe comparisons showed the same-culture dyads not using the collaboration script to display a significantly higher frequency of organizing work and initiating activities than the same-culture dyads using the collaboration script. The descriptive statistics for the online collaborative behavior of the same- versus mixed-culture dyads either using or not using the collaboration script are presented in Table 4.

For the contributing subcategories (i.e., help giving, feedback giving, exchange resources, sharing knowledge, challenging, and explaining), a significant main effect of group composition was found (*Wilks' Lambda*, $\lambda = .71$, $F(6, 56) = 3.23$, $p < .01$, $\eta^2 = .26$) but no significant main effect of script condition ($F(6, 56) = .52$, $p = .79$, $\eta^2 = .06$) or significant interaction between script condition and group composition ($F(6, 56) = .69$, $p = .65$, $\eta^2 = .07$). Across the board and thus independent of script condition, the same-culture dyads produced a higher frequency of Contributing activities than the mixed-culture dyads.

For the frequency of utterances reflecting the Seeking input category of collaborative behavior (i.e., the subcategories feedback seeking, advocating effort, help seeking), a significant interaction between script condition and group composition was found (*Wilks' Lambda*, $\lambda = .85$, $F(3, 59) = 3.02$, $p < .05$, $\eta^2 = .14$) accompanied by a significant main effect of script condition (*Wilks' Lambda*, $\lambda = .82$, $F(3, 59) = 3.63$, $p < .05$, $\eta^2 = .14$) but no significant effect of group composition (*Wilks' Lambda*, $\lambda = .97$, $F(3, 59) = .46$, $p = .71$, $\eta^2 = .17$). Post-hoc Scheffe comparisons showed the students in the mixed-culture dyads using the collaboration script to seek more feedback from their partner than the students in the other three types of dyads (see Table 4).

There were no significant main or interaction effects for the collaborative behavior category of reflection/monitoring, which included the subcategories reflecting on medium and monitoring group effort.

For the social interaction category of collaborative behavior, which was composed of only comments on social matters, there was only a significant interaction between script condition and group composition, ($F(1, 59) = 4.74$, $p < .05$, $\eta^2 = .08$). The mixed-culture dyads using the collaboration script produced a significantly higher frequency of Social interaction than the students in the other three types of dyads.

4.3. Quality of online discussions (RQ2)

The results of the MANOVA with collaboration script (with vs. without) and group composition (same vs. mixed culture) as the independent variables and three aspects of the quality of the students' online discussions as the dependent variables (i.e., justification and reasoning, breadth of discussion, and depth of discussion) revealed a significant main effect of group composition (Wilks' Lambda, $\lambda = .86$, $F(3, 59) = 2.86$, $p < .05$, $\eta^2 = .14$). There was no significant main effect of script condition (Wilks' Lambda, $\lambda = .89$, $F(3, 59) = 2.12$, $p = .10$, $\eta^2 = .11$) and no significant interaction between script condition and group composition (Wilks' Lambda, $\lambda = .95$, $F(3, 59) = .90$, $p = .44$, $\eta^2 = .05$). Independent of script condition, thus, the same-culture dyads showed a higher quality of online discussion than the mixed-culture dyads. In Table 5, the descriptive statistics for the quality of the students' online discussions are reported.

5. Discussion

To develop a deeper understanding of how socio-cultural factors and aspects of a CSCL environment can affect different groups of students working collaboratively online, we designed and implemented a collaboration script for students to use in same- versus mixed-culture dyads working in a CSCL environment. The online collaborative behaviors and quality of the group discussions displayed in the different groups were then analyzed. The results showed the following.

- The mixed-culture dyads using the collaboration script displayed more seeking input and social interaction than the other three groups of dyads (i.e., the mixed-culture dyads not working with the collaboration script, the same culture dyads working either with or without the collaboration script).
- The same-culture dyads using the collaboration script displayed less planning activity than the same-culture dyads not using the collaboration script but no such difference was found for the mixed-culture dyads.
- Independent of script condition, the same-culture dyads displayed more contributing activity than the mixed-culture dyads.

Table 5
Mean quality of online discussion according to cultural composition of group and use of collaboration script.

Group composition	Measure of discussion quality	Collaboration script					
		With script		Without script		Total	
		Mean	SD	Mean	SD	Mean	SD
Mixed culture	Breadth of discussion	1.71	.82	1.62	.80	1.66	.80
	Depth of discussion	1.64	.84	1.31	.60	1.46	.73
	Justification and Reasoning	2.38	.33	2.34	.31	2.36	.32
Same culture	Breadth of discussion	2.46	.64	2.07	.83	2.27	.75
	Depth of discussion	2.06	.70	1.71	.91	1.89	.81
	Justification and Reasoning	2.51	.31	2.58	.46	2.54	.38
Total	Breadth of discussion	2.10	.82	1.83	.83	1.96	.83
	Depth of discussion	1.86	.78	1.50	.77	1.67	.79
	Justification and reasoning	2.44	.32	2.45	.40	2.44	.36

- Independent of script condition, the same-culture dyads produced a higher quality of online discussion than the mixed-culture dyads.

With regard to our first research question, namely Do group composition (same- versus mixed-culture dyads) and the use of a specially designed collaboration script (with vs. without) affect students' online collaborative behavior in a computer-supported collaborative learning environment?, the mixed-culture dyads using the collaboration script sought more input and produced more social interaction than the students in the other three types of dyads. It appears that the collaboration script effectively fostered five categories of collaborative behavior, which is exactly what it was designed to do (see Table 4). The interaction dynamics of the culturally mixed dyads of students in particular appeared to improve as a result of the collaboration script.

Mixed-culture groups are more likely to experience misunderstandings and task coordination difficulties than same-culture groups working on a similar task. The difficulties that characterize mixed-culture groups often result in decentralized thinking, divergence in collaborative learning activities, and lack of agreement on the general course of action to be taken. In the present study, the collaboration script effectively fostered more frequent questioning, requests for feedback, requests for information, and checks to make sure that the collaborating partners were "on the same page."

The results of this study are consistent with the results of previous studies in that they show students in mixed-culture learning groups to experience difficulties with expressing disagreement unless they are explicitly encouraged to express any disagreement (e.g., Chen et al., 2006; Kim & Bonk, 2002; Setlock et al., 2004). Our findings also showed the culturally mixed dyads using the collaboration script to more frequently seek input and especially feedback during task performance than the other three groups of dyads (i.e., the mixed-culture dyads not working with the collaboration script, the same culture dyads working either with or without the collaboration script). Frequency of seeking input (i.e., making assertions, raising questions) thus appears to be a good predictor of students' level of engagement in online exchanges.

In the present study, the mixed-culture dyads using the collaboration script also showed greater social interaction than the other three groups of dyads. The collaboration script instructed the students to interact socially online and the students appeared to do this. In fact, the mixed-culture dyads using the collaboration script exhibited a greater exchange of utterances for social interaction throughout the collaborative task than the mixed-culture dyads not using the collaboration script and the same-culture dyads with and without the script. This finding is in line with the research of Lim and Liu who state that "social–emotional priority is given to self-protection rather than positive articulations such as solidarity building in culturally mixed groups in CSCL" (2006, p.149). That is, the use of the collaboration script helped the culturally mixed dyads, in particular, work on rapport and build a good working relationship during the collaboration process. In contrast, the culturally mixed dyads not using the collaboration script were observed to communicate their messages very carefully in order to ensure that their collaborative partners would understand the messages as intended. This sentiment is captured by utterances that the students frequently added at the ends of their messages, e.g., "Please let me know if what I wrote is clear to you", "Do you understand my point?", "I'd like to double check whether you understood my message".

The finding of increased social interaction is also consistent with the findings of Jeong (2006) who found that more social interaction tends to unfold as the discussion between collaborative partners develops. "As the potential for tension and conflict grows with each additional exchange of contentious messages and responses," (Jeong, 2006, p. 390) the need to maintain a positive working relationship and thus social interaction grows. This pattern was especially true for the mixed-culture dyads using the collaboration script. Increased feedback seeking (i.e., questioning, requests for feedback and information, requests for feedback to resolve conflicts/misunderstandings)

was fostered by the collaboration script and also increased the degree of online social interaction in the mixed-culture dyads in particular.

Our results show the same-culture dyads using the collaboration script to produce a relatively lower frequency of behavior concerned with planning (e.g., the organization of the work, the initiation of activities) than the same-culture dyads not using the collaboration script. The introduction of the collaboration script thus appeared to fulfill many of the planning functions that otherwise had to be addressed by the dyads not using the script: agreement on a specific course of action and clear articulation of how to proceed. That is, the same-culture dyads working with the collaboration script required less attention to planning functions than the same-culture dyads not working with the collaboration script while this difference was not found for the mixed-culture dyads — these dyads devoted equally high amounts of time to the planning functions. The students in the culturally mixed dyads in our study were presumably aware of the differences in their backgrounds right from the beginning of their collaboration and certainly had to devote more exchanges to establishing the collaboration, understanding the assignment, and agreeing upon a course of action (i.e., planning) than the students in either of the same-culture dyads.

Further with regard to the extent of contributing collaborative behavior, the same-culture dyads tended to provide more feedback, exchange more resources, share more knowledge, challenge contributions more, and explain or elaborate one's position more than the mixed-culture dyads — independent of script condition. Students working in same-culture dyads presumably do not encounter the same challenges or barriers to communication and collaboration as students working in mixed-culture dyads. Once the dyad has been established and some initial planning has been made, most of the students in the same-culture dyads therefore concentrated on task completion and produced contributions mostly aimed at this. Differences of opinion are quickly discussed and resolved, as indicated by the high frequency of "explaining" interactions. In contrast, in the mixed-culture dyads, the students must spend more time building rapport and therefore have less time to exchange task-related information and explain their positions on things.

With regard to our second research question, namely Do group composition (same- versus mixed-culture dyads) and the use of a specially designed collaboration script (with vs. without) affect the quality of the students' discussions in a computer-supported collaborative learning environment?, the results showed — not surprisingly — the same-culture dyads to produce higher quality discussions than the mixed-culture dyads independent of script condition. This result can be attributed to both socio-cultural and technological factors. Same-culture dyads not only share similar values, customs, and social structures, which can minimize the effort needed to reach a shared understanding but also facilitate task performance (Cho & Lee, 2008; Shi et al., 2013). The lack of nonverbal cues and other visual information in an online environment can complicate the flow of communication and mutual understanding resulting in the impaired coordination of processes, inefficient exchange of information, and less fruitful discussion — no matter what the composition of a collaborative group. When the need for effective communication becomes larger, moreover, problems for mixed-culture dyads in particular will arise. In keeping with this, the mixed-culture dyads relative to the same-culture dyads in our study exhibited a lower level of content-oriented interactions during the discussion task. In other words, the students collaborating in same-culture dyads did not appear to experience the same barriers and challenges as the students collaborating in mixed-culture dyads. The collaboration script could not bridge this gap and, as a result, the same-culture dyads produced better quality discussions online than the mixed-culture dyads online.

The differences in the quality of the discussions produced by the mixed- versus same-culture learner dyads can be further explained by a tendency to want to avoid conflict in the mixed-culture dyads in particular and especially the mixed-culture dyads not using the collaboration script. The same-culture dyads in our study displayed a higher frequency of contributing behavior (i.e., help giving, feedback giving, exchange resources, sharing knowledge, challenging, and explaining) than the mixed-culture dyads. More contributing (especially challenging and explaining) collaborative learning behaviors can be regarded as a direct result of more disagreement and the subsequent sharing of different points of view. In terms of discourse processes, it is the sharing of differences that can spark and elicit explanation. Engaging in not only challenging but also explanatory interaction provides more opportunities for discussion, which means that conflict avoidance and a focus on consensual forms of interaction will only lead to fewer opportunities for productive discussion (Jeong, 2006).

This finding is in keeping with the Piagetian approach to socio-cognitive conflict in which it assumed that the efficacy of collaborative learning can be influenced by the extent to which students not only identify but also discuss conflicts in their knowledge and beliefs by asking questions, explaining, and providing extra information to support their viewpoints (De Lisi & Goldbeck, 1999). Such an approach holds for an individualist culture (e.g., students from North America, Western Europe), whereas a much more consensual approach to collaboration is known to predominate in a collectivist culture (e.g., students from Ecuador, Indonesia) (Hofstede, 1991; Vatrapu & Suthers, 2007). In both individualist and collectivist cultures, when disagreements and conflicts are avoided and thus not verbalized and discussed, positive CSCL outcomes are not likely to occur.

Challenging, explanation/elaboration, seeking input can be expected to happen more frequently in mixed-culture dyads simply because the students in such groups bring a variety of perspectives, skills, and decision-making strategies to the task at hand (Maznevski, 1994). However, the following factors probably work against the expression of conflict and alternative viewpoints with the required explanation/elaboration: self-protection, anxiety, and the uncertainty associated with working with people from different cultural backgrounds; miscommunications; difficulties expressing disagreement; and an unwillingness to openly disagree. These factors can hamper the exchange of new information and ideas, with less efficient forms of online collaboration occurring as a result. In other words, simply placing people with different cultural backgrounds together in a group does not guarantee the occurrence of productive socio-cognitive conflict and collaborative learning. "High-performing" culturally mixed groups that are capable of capitalizing upon their diversity and not being constrained by it must be established (McCorkle et al., 1999).

5.1. Suggestions for future research

Some possible limitations on the present study are as follows. First, generalizations based on a population of international students should be interpreted with caution. The findings may not be completely transferable to students living in their "native" cultures, for example. Long-term residence in a foreign country can be assumed to create at least some cultural assimilation of the host culture. The cultural differences between two students in a mixed-culture dyad collaborating online but in otherwise the same country may therefore not only be as big as the cultural differences between two students collaborating online but also from different country locations.

Second, the contribution of individual personal characteristics in addition to cultural background characteristics to the intercultural collaborations assessed in our study cannot be ruled out (Ting-Toomey, Oetzel, & Yee-jung, 2001). Cultural differences cannot be reduced to individual differences (see Na et al. (2010) for a review), which means that the operation of individual differences cannot be ruled out by attention to cultural differences. It is therefore suggested that the possible influence of individual differences, which can be handled not only by using larger sample sizes but also the conduct of qualitative case analyses, be investigated in future studies.

A third possible limitation on the present study is the degree to which the findings can be generalized in light of the collaboration task employed. The assignment of a task with intercultural communication as the topic for online discussion probably called upon information that was particularly salient for the students in the culturally mixed dyads. The generalizability of the present findings to situations in which intercultural communication is not the topic may thus be limited. Studies involving a learning/discussion topic that is not itself concerned with intercultural communication are therefore called for in the future. Research involving not only other types of tasks but also assignments that require students to transfer what they have learned should also be undertaken in the future.

A final possible limitation on the present study is that the students collaborated for only a brief period of time. The effects of cultural diversity and the use of collaboration scripts can presumably change over time — as students become familiar with each other and familiar with the recommended procedures. The result of prior research suggests that the internalization of external scripts by learners requires a relatively long period of exposure and drilling (Kollar et al., 2007). It is therefore recommended that further research be undertaken to replicate not only the present findings in studies spanning a longer period of time but also studies using a variety of online discussion assignments to stimulate internalization.

5.2. Implications and concluding remarks

The present study provides insight into the ways in which same-versus mixed-culture dyads interact in a CSCL environment. The findings can guide instructional designers and educators in the optimal design and implementation of learning environments within an intercultural collaborative learning context. Specifically attending to cultural differences can help improve the learning experiences of students in multicultural settings. A learner's behavior in a collaborative task situation and their reactions to the collaborative partner(s) can be used to predict the level of engagement in collaborative learning activities and thereby the effective use of technology for educational purposes. Interventions can be designed to explicitly stimulate interaction and guide the interaction within an online collaborative learning environment. This can conceivably be done by the learners themselves, educators, or even using machine learning techniques to identify potential problems and then prevent their occurrence during an exchange. For example, social interaction can be encouraged during the early stages of online collaboration in the form of — for instance — the exchange of personal profiles and introductory exchanges. The addition of nonverbal content to a CSCL system (e.g., a real time video connection, audio information) can further facilitate the effective exchange of information. Students' awareness of different styles of communication can be heightened using special features of CSCL tools to implement an adaptive scripting approach as developed by Gweon, Rosé, Zaiss, and Carey (2006) or to introduce illustrative examples and transcripts (Kim & Bonk, 2002). Adaptive scripting focuses on the matching of students with learning partners to produce optimal learning conditions. It also focuses on the provision of adaptive prompts to encourage in-depth explanation.

The present study lays the foundation for the design of external collaboration scripts that pay attention to the cultural backgrounds of students for use in CSCL environments. With the integration of the present findings and previous findings on the use of collaboration scripts to facilitate CSCL and also intercultural learning (e.g., Vatrapu & Suthers, 2007; Weinberger et al., 2007), collaboration scripts that incorporate cultural enrichment elements can be developed for specific groups of students engaged in collaboration. The enrichment elements can be derived from cross-cultural psychology and studies of international relations among other fields (e.g., Hofstede, 1991; Nisbett, 2003). For example, students from Western countries have been shown to focus their communication on the task at hand and not on relationships during the early stages of collaborative work. In contrast, students from East-Asian countries have been showing to give priority to the establishment and maintenance of harmonious relationships within a collaborative group as opposed to task accomplishment (Hofstede, 1991; Vatrapu & Suthers, 2007). This means that group members coming from Western countries may unintentionally offend group members coming from East-Asian countries at times by omitting aspects of social interaction due to a focus on task accomplishment. A potential solution is to introduce a socialization protocol that encourages collaborators to first get to know each other and build the group dynamics that are needed to for task accomplishment in mixed-culture groups. Collaborative partners should be encouraged to identify not only individual but also cultural similarities and differences. This can be realized via the exchange of not only personal profiles as part of the introduction process but also task expectations. A socialization protocol can thus help fulfill the needs of culturally distinct groups during the initial stages of a collaboration endeavor. Furthermore, during the problem-solving phase of a collaborative learning task, interculturally-enriched collaboration scripts can encourage students from Western countries to share as many ideas and much information as possible, critically assess their partners' contributions, and also allow sufficient time for their partners to prepare their response; interculturally-enriched collaboration scripts can encourage students from East-Asian countries to feel free to disagree with their partners, be as direct as possible in their communication, and be specific as possible when communicating.

More detailed research on the particular behavioral patterns of challenging, feedback seeking, and explaining/elaborating is nevertheless needed in order to better understand how engagement in high-level collaboration processes can be fostered. Previous research has shown that learning is particularly likely to occur when the collaborating students engage in constructive argumentation (i.e., challenge each other's positions, feel free to express alternative viewpoints, and attain a synthesis via productive discussion) (Baker, 2003; Cho & Jonassen, 2002). The supply of script instructions to foster critical discussion in groups including students from cultures that tend to avoid conflict can be seen as a promising approach to promote greater engagement in productive debate and greater quality of learning. Collaborative scripts can provide sentence openers like "I think that you did a good job explaining that, but what about …". They can also prompt students to serve as the presenter on one occasion and the reviewer on another occasions (i.e., adopt different roles and thus perspectives at times) (see Weinberger et al. (2005) for an overview).

To conclude, the findings of this study enable researchers and educators to construct collaborative learning environments in which cultural differences can at least be accommodated and even put to work to promote effective cross-cultural interaction and learning within a CSCL environment.

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