Measuring Social Aspects of Distributed Learning Groups

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ABSTRACT Computer-supported group-based learning requires that interaction has to be structured within the group; otherwise it will not happen. Also, it is important to pay attention to social aspects of a distributed learning group (i.e. group dynamics); otherwise a good working team will not emerge. This article proposes a process-oriented framework that considers five critical elements for enhancing interaction in the cognitive dimension. Enhancing social interaction for achieving a sound social space requires a sociable computer-supported collaborative learning environment (CSCL) in which social presence of the group members exists. Such sound social space is considered by many, if not most, educational researchers to be a necessary prerequisite for epistemic interaction. In order to allow designers and teachers to develop sociable CSCL environments, this article proposes three scales to measure social aspects. Although the validation of these scales is somewhat limited, the scales are a first step for making certain characteristics of distributed interaction visible. To provide a more firm base for the scales, this article also calls for more research on this issue.

Introduction

Computer-supported collaborative learning (CSCL) embraces the social constructivist view. Consequently, CSCL presumes collaboration in small groups which, in turn, presumes that groups have evolved into good working teams. The latter indicates that not only the technological and the task-related cognitive aspects are of importance, but also the social aspects (Jochems et al, 2004). However, despite this recognition, the current research literature on CSCL reports that there are problems related to both collaboration and social aspects.

Although interaction evidently is a prerequisite for collaborative learning (see, for example, Vygotsky, 1978; Schegloff, 1991; Hiltz, 1994; Wagner, 1997), we have identified two pitfalls salient in CSCL that are negatively influencing collaborative learning (Kreijns et al, 2003). Pitfall 1 takes interaction for granted. Indeed, the abundance of communication media suggests this assumption. However, interaction is not just happening in distributed groups (or even in face-to-face groups) and, therefore, should be intentionally designed into the learning tasks. Kearsley (1995), for instance, found that almost all recommendations emphasize that interactivity must be planned or it is unlikely to occur (or be meaningful) (pp. 87, 88) and Berge (1999) makes this point clear by stating that ‘interaction does not simply occur but must be intentionally designed into the instructional program’ (p. 5). Pitfall 2 restricts social interaction only for socio-cognitive processes. Indeed, socio-cognitive processes are the most important processes to consider and, therefore, are subsequently the dominant focus of educational research. However, interaction is also necessary for creating a sound social space meeting essential social psychological features in groups (e.g. group cohesion, trust and a sense of community) that facilitate effective collaborative learning.
Wegerif (1998) pointed out that ‘many evaluations of asynchronous learning networks understandably focus upon the educational dimension, either learning outcomes or the educational quality of interactions, overlooking the social dimension which underlies this’ (p. 34). The observation is confirmed by Cutler (1996) who remarked that the ‘current literature surrounding CMC is almost entirely task-based and focused on cost, efficiency, and productivity with little attention given either to the changes effected on the people or to the social relations created from using the communication technologies’ (p. 320).

In order to avoid the negative implications of falling into these pitfalls, we explicitly consider interaction in collaborative learning not only to have a cognitive (i.e. educational) dimension but also to have a socio-emotional (i.e. social) dimension. Indeed, Rovai (2004) states that an ‘important aspect of community building is for learners to have the means and opportunities to become engaged in both educational and social experiences’ (p. 87). We will focus on the social dimension of interaction in distributed learning groups, especially on the question how to enhance social processes in distributed learning.

This contribution starts with a theoretical section in which we present two frameworks respectively for avoiding the two pitfalls. The first framework focuses on the structuring of social interaction within distributed learning groups with respect to the cognitive dimension. The second framework focuses on social interaction for collaboration in the socio-emotional dimension. Because our study elaborates on social aspects, the first framework is discussed briefly while the second framework is delineated in more detail, thereby introducing the three constructs sociability, social space and social presence. We consider these constructs to be central in designing sociable CSCL environments, i.e. environments that explicitly take social aspects into consideration. Three scales were developed for measuring sociability, social space and social presence. The method section describes the methodology chosen for validating these scales while the results section reports our findings. Finally, the discussion section evaluates our findings and discusses the implications of taking social aspects into account when designing social interaction in distributed groups.

Theoretical Background

A Framework for Enhancing Social Interaction in the Cognitive Dimension

Pitfall 1 warns us that from a social point of view interaction cannot be taken for granted but has to be designed intentionally into the tasks. A number of educationalists and educational researchers have done research on this area and have suggested a number of ways for accomplishing this either by addressing social interaction directly or by addressing participation that is affecting social interaction. Strijbos et al. (2004a) propose one such way. They present a framework for a process-oriented methodology towards group-based learning in a CSCL environment. This framework is aiming at stimulating educational designers to adopt a systematic approach for group-based learning design so as to draw out the desired type of interaction amongst the group members by paying attention to five critical elements that affect interaction. The five critical elements are: learning objectives, task-type, level of pre-structuring, group size and computer support.

If the learning objective emphasizes closed skills (i.e. skills that are relatively fixed and that can be learned separately), then it is not likely that this setting will provoke reciprocal interaction, as will be the case when the objective emphasizes open skills (i.e. skills that require argumentation and negation). Task type refers to the degree to which a task is well structured or ill structured. A well-structured task aims for convergence while applying a clear set of rules and principles and, thus, requires less interaction. An ill-structured task usually does not have a clear-cut solution and it is uncertain which set of rules and principles is most appropriate. Therefore, ill-structured tasks require intensive interaction in order to achieve common ground and to find consensus. The kind of interaction also is dependent on the level of prestructuring of the setting by either teacher or designer, through either instruction or the technical environment, to stimulate or ensure both positive interdependency and individual accountability. The continuum for prestructuring ranges from high prestructuring to low prestructuring and can be affected both at the cognitive and the social dimension. Although the literature reporting research investigating the effects of group size on interaction is sparse, there are indications that group size is related to different interaction
patterns or learning benefits, especially if participation equality or share products are required. Group size is, therefore, identified as the fourth critical element. Finally, computer support can be provided to students. However, the different communication tools do not equally afford the same opportunities for interaction. As a consequence, different communication tools affect interaction in different ways. It is, however, unclear in which way it affects interaction in group-based learning because, as research shows, communication tools often are used by students in unintended ways which are sometimes not even desirable for educational purposes.

In the next two paragraphs we present two examples from our own research with respect to enhancing social interaction. The first example examines roles in distributed groups (Strijbos et al, 2004b). Small group researchers have found group performance effectiveness to be largely dependent on coordination. However, most of the time coordination is difficult to achieve in distributed groups. It was hypothesized that functional roles might stimulate group coordination. A functional role refers to a duty or a responsibility of a group member pertaining to a specific part of the work. Examples of a functional role are project planner, communicator, reporter, or data collector. In a series of experiments learning groups with roles and without roles have been compared by analyzing the group members’ behaviours and comparing group performances using questionnaires. The findings showed that role groups did not outperform the non-role groups, but roles appeared to increase students’ awareness of interaction and efficiency and stimulated efficiency through cohesion. Additionally, it appeared that predominantly group members performed their roles quite loosely; a strict role behaviour might have limited their actions.

The second example investigates reflection as a means for increasing participation in groups (Dewiyanti et al, 2005). In order to reach group goals, members have to assess and evaluate the ongoing group processes. In essence, this means reflecting on how well the group is functioning and integrating all group members’ skills and knowledge. It was hypothesized that stimulating reflection might contribute to regulation processes. A number of learning groups received guidelines about norms for participation and activities for regulating group processes. Moreover, members of these learning groups discussed the group process twice. In the control condition comparable learning groups did not receive these guidelines and interventions. A comparison of both conditions did not show significant differences with respect to their final performances. However, students in the experimental condition planned and monitored group procedures more often than the students in the control condition. Furthermore, the students in the experimental condition experienced more and better regulation of the group processes.

A Framework for Enhancing Social Interaction in the Socio-emotional Dimension

Pitfall 2 warns us not to restrict interaction to cognitive processes, but to include social processes as well. Yet, a vast number of educationalists and educational researchers do not recognize the importance of socio-emotional processes and therefore do not pay attention to the social-psychological dimension of collaborative learning. As a result, ICT-based environments are developed that lack support for socializing. These environments are purely functional for they contain only, in varying degrees, educational functionalities. Not surprisingly, literature reports that these functional environments do not always fulfil their objectives due to problems with activating collaborative learning for social construction of knowledge, critical thinking, and deep understanding (e.g. Hughes & Hewson, 1998) that can be traced back to problems with group formation and group dynamics (Taha & Caldwell, 1993; Hobaugh, 1997; Hughes & Hewson, 1998). What is needed is an attractive, sociable CSCL environment that incorporates social functionalities, creating the conditions for socialization to happen and transforming the functional CSCL environment into a human oriented environment.

A sociable CSCL environment is one aspect; another one is that we have to arrive at what we would like to call a sound social space in a distributed learning group. We define a social space as the human network of social relationships between group members which is embedded in group structures of norms and values, rules and roles, beliefs and ideals (Kreijns et al, 2004). We designate a social space to be ‘sound’ if the social space is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community. Rourke especially stresses the importance of a sound social space: ‘if students are to offer their
tentative ideas to their peers, if they are to critique the ideas of their peers, and if they are to interpret others’ critiques as valuable rather than as personal affronts, certain conditions must exist … students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage willfully in collaboration and recognize the collaboration as a valuable experience’ (Rourke, 2000). He emphasizes that in order to elicit these conditions students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage willfully in collaboration. In general, a sound social space is not only (1) enabling the social interaction necessary for collaboration, (2) facilitating learning behaviour, and (3) increasing individual learning performance (Gunawardena, 1995; Wegerif, 1998; Brandon & Hollingshead, 1999; Rovai, 2001), but is also reducing feelings of loneliness and isolation thereby reducing drop-out (Phillips, 1990; Rovai, 2001).

However, the emergence of a sound social space may be problematic in CSCL environments. These CSCL environments commonly utilize text-based computer-mediated communication (CMC) such as email and discussion groups. Due to the limited bandwidth, this type of CMC is hampering the transmission of visual and non-verbal cues, which is seen as important for impression formation – the process of getting to know each other. Impression formation, in turn, is seen as important for the development of interpersonal relationships (Short et al, 1976; Kiesler et al, 1984), which are a prerequisite for the emergence of a sound social space. In her studies, Hiltz (1998) concluded that one ‘of the potential negative effects of online courses is a loss of social relationships and a sense of community that is usually present on a traditional campus’ (Hiltz, 1998).

However, much critique is given on this line of thinking. Walther (1992), for instance, argued that impression formation does not depend on whether visual cues are available or not. On the contrary, the absence of visual cues is even beneficial for creating hyper personal effects (Walther, 1996). In addition, Reicher et al (1995) argued that the absence of visual cues and other identifying cues generates a group identity that has a positive effect on group dynamics in terms of adherence to group norms and social cohesiveness, but at the expense of losing the unique individual identities of group members (which they see as a benefit). Nevertheless, even those critics acknowledged that the limited bandwidth of CMC influences the way in which the communication happens and, thus, deeply affects the socializing processes and the emergence of a sound social space, either for the good or bad.

**Measuring Social Aspects**

There are a number of instruments purporting to measure social aspects in CSCL environments, most notably amongst them, social presence (Short et al, 1976; Gunawardena, 1995; Gunawardena & Zittle, 1997). However, instruments measuring social presence sometimes are used for measuring the social climate in a collaborating group (Rourke & Anderson, 2002) or the students’ feelings towards the medium (Gunawardena, 1995), thereby confounding construct validity of the existing instruments. Moreover, test items of the social presence instruments overlap in items that are used to measure group atmosphere (Fiedler, 1962) or group cohesiveness (Price & Mueller, 1986). Our research seeks the disentanglement of all these constructs and has (re)defined the constructs social space (already discussed), sociability, and social presence and developed instruments for each of these. The next paragraph introduces both the constructs sociability and social presence.

Not every CSCL environment has the ability to enable the emergence of a sound social space. It depends on whether these environments incorporate social functionalities for supporting socialization or not. The concept of sociability is introduced for expressing differences between CSCL environments in their ability to enable the emergence of a social space. We define sociability as the extent to which an ICT-based environment is perceived to be able to facilitate the emergence of a sound social space (Kreijns et al, in press). Another important issue related to social space is the concept of social presence because it influences social interaction. (Gunawardena, 1995; Tammelin, 1998; Tu, 2000, 2002; Tu & McIsaac, 2002). Short et al (1976) originally defined social presence as the ‘degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships’ (p. 65). We define social presence as the perceived degree of illusion
that the other in the communication appears to be a ‘real’ physical person in either an immediate (i.e. real time or synchronous) or a delayed (i.e. time-deferred or asynchronous) communication episode. Tu (2000), linking social learning theory to the concept of social presence, contends that social presence ‘is required to enhance and foster online social interaction, which is the major vehicle of social learning’ (p. 27). If 'social presence is low, the foundation of social learning, social interaction, does not occur’ (p. 30). Rourke et al (1999) point to two important functions of social presence in their community of inquiry model: (1) it supports ‘cognitive objectives through its ability to instigate, sustain, and support critical thinking’ (p. 52); (2) it supports ‘affective objectives by making group interactions appealing, engaging, and thus intrinsically rewarding’ (p. 52).

The Three Scales

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Component 1. Positive Group Behaviour</th>
<th>Component 2. Negative Group Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Group members felt free to criticize ideas, statements, and/or opinions of others</td>
<td>3.29</td>
<td>1.03</td>
<td>.69</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>We reached a good understanding on how we had to function</td>
<td>2.44</td>
<td>1.32</td>
<td>.75</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Group members ensured that we kept in touch with each other</td>
<td>3.10</td>
<td>1.11</td>
<td>.79</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>We worked hard on the group assignment</td>
<td>2.90</td>
<td>1.30</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I maintained contact with all other group members</td>
<td>2.78</td>
<td>1.31</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Group members gave personal information on themselves</td>
<td>2.82</td>
<td>1.07</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>The group conducted open and lively conversations and/or discussions</td>
<td>2.59</td>
<td>1.15</td>
<td>.85</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Group members took the initiative to get in touch with others</td>
<td>2.84</td>
<td>1.11</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Group members spontaneously started conversations with others</td>
<td>2.66</td>
<td>1.10</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Group members asked others how the work was going</td>
<td>3.15</td>
<td>1.12</td>
<td>.70</td>
<td></td>
</tr>
</tbody>
</table>

Table I. The Social Space Scale. Note. For items (refined Social Space Scale) 1-12: judgements were made on 5-point Likert scales (1 = not applicable at all; 2 = rarely applicable; 3 = moderately applicable; 4 = largely applicable; 5 = totally applicable). For items (refined Social Space Scale) 13-20: judgements were made on 5-point Likert scales (1 = very rarely or never (on average less than once a month), 2 = rarely (on average once a month), 3 = sometimes (on average a few times a month), 4 = often (on average a few times a week), 5 = always or very often (on average a few times a day). These items were reverse coded for analysis.

The Social Space Scale (Kreijns et al, 2004) measures the degree of the perceived quality of the social space that exists in an asynchronous distributed learning group. The scale has two dimensions: Positive Group Behaviour and Negative Group Behaviour. Each dimension contains 10 five-point Likert scale items. The Social Space Scale is depicted in Table I.
Measuring Social Aspects of Distributed Learning Groups

The Sociability Scale (Kreijns et al, in press) measures the perceived degree of sociability of ICT-based environments. It is a one-dimensional scale consisting of 10 items. The Sociability Scale is depicted in Table II.

The Social Presence Scale (Kreijns et al, submitted) measures the perceived degree of social presence in ICT-based environments. It is a one-dimensional scale consisting of five items. Table III depicts the Social Presence Scale.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Component 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>This CSCL environment enables me to easily contact my team mates</td>
<td>3.30</td>
<td>1.03</td>
<td>.77</td>
</tr>
<tr>
<td>2</td>
<td>I do not feel lonely in this CSCL environment</td>
<td>2.90</td>
<td>1.18</td>
<td>.69</td>
</tr>
<tr>
<td>3</td>
<td>This CSCL environment enables me to get a good impression of my team mates</td>
<td>2.58</td>
<td>0.98</td>
<td>.80</td>
</tr>
<tr>
<td>4</td>
<td>This CSCL environment allows spontaneous informal conversations</td>
<td>2.75</td>
<td>1.14</td>
<td>.68</td>
</tr>
<tr>
<td>5</td>
<td>This CSCL environment enables us to develop into a well-performing team</td>
<td>2.76</td>
<td>1.05</td>
<td>.80</td>
</tr>
<tr>
<td>6</td>
<td>This CSCL environment enables me to develop good work relationships with my team mates</td>
<td>3.19</td>
<td>1.05</td>
<td>.84</td>
</tr>
<tr>
<td>7</td>
<td>This CSCL environment enables me to identify myself with the team</td>
<td>2.96</td>
<td>1.07</td>
<td>.79</td>
</tr>
<tr>
<td>8</td>
<td>I feel comfortable with this CSCL environment</td>
<td>3.44</td>
<td>1.06</td>
<td>.83</td>
</tr>
<tr>
<td>9</td>
<td>This CSCL environment allows for non-task-related conversations</td>
<td>3.61</td>
<td>0.99</td>
<td>.69</td>
</tr>
<tr>
<td>10</td>
<td>This CSCL environment enables me to make close friendships with my team mates</td>
<td>2.49</td>
<td>1.13</td>
<td>.73</td>
</tr>
</tbody>
</table>

Table II. The Sociability Scale. Note. Judgements were made on 5-point Likert scales (1 = not applicable at all; 2 = rarely applicable; 3 = moderately applicable; 4 = largely applicable; 5 = totally applicable).

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>When I have real-time conversations in this CSCL environment, I have my communication partner in my mind's eye</td>
<td>2.15</td>
<td>1.17</td>
<td>.80</td>
</tr>
<tr>
<td>2</td>
<td>When I have asynchronous conversations in this CSCL environment, I also have my communication partner in my mind's eye</td>
<td>2.75</td>
<td>1.16</td>
<td>.70</td>
</tr>
<tr>
<td>3</td>
<td>When I have real-time conversations in this CSCL environment, I feel that I deal with very real persons and not with abstract anonymous persons</td>
<td>2.90</td>
<td>1.50</td>
<td>.79</td>
</tr>
<tr>
<td>4</td>
<td>When I have asynchronous conversations in this CSCL environment, I also feel that I deal with very real persons and not with abstract anonymous persons</td>
<td>3.56</td>
<td>1.21</td>
<td>.79</td>
</tr>
<tr>
<td>5</td>
<td>Real-time conversations in this CSCL environment can hardly be distinguished from face-to-face conversations</td>
<td>1.81</td>
<td>1.01</td>
<td>.69</td>
</tr>
</tbody>
</table>

Table III. The Social Presence Scale. Note. Judgements were made on 5-point Likert scales (1 = not applicable at all; 2 = rarely applicable; 3 = moderately applicable; 4 = largely applicable; 5 = totally applicable).

Method

Participation

Data were collected from students in three distance education courses at the Open Universiteit Nederland (OUNL). The first ‘course’ is the Virtual Environmental Consultancy (VEC) of the Department of Natural Sciences (n = 35; 25 males, 10 females). Students were assigned to one of
eight groups. Group size was between three and eight members. Groups had to produce an Environmental Advice Report. Students used eRoom version 5.4 (www.eroom.com) as their CSCL environment.

The two other courses were taken from the Statistics Education Innovation Project at the Department of Psychology. Thirty-eight adult undergraduates (all Dutch OUNL students, 6 male and 32 female) enrolled in the first course (designated here as 'Stat 1') and were assigned to one of seven groups consisting of five or six members each. However, the group sizes changed because two female students were non-starters and during the course 10 students (2 males, 8 females) dropped out. Groups had to produce a prototype of a research paper. The groups made use of Studynet, the CSCL environment of the OUNL. In Studynet, asynchronous communication occurred through newsgroups and real-time communication via Microsoft Netmeeting. Telephone and email use were prohibited.

One hundred and thirteen adult undergraduates (all Dutch OUNL students, 34 male and 79 female) enrolled in the second course (designated here as 'Stat 2'). Students were assigned to one of eight ‘slow’ groups, eight ‘fast’ groups, or two ‘free’ groups. Slow and free groups had approximately twice the time of fast groups to complete the course. Collaboration was compulsory for the slow and fast groups, and voluntary for the free groups. Half of the slow groups and half of the fast groups had four members; the remaining slow and fast groups had eight members. The group sizes of the two free groups were respectively 5 and 12 members. However, this course had six female students who were non-starters. During the course, 14 students (4 males, 10 females) dropped out and 18 students moved to another group. In addition, one slow group discontinued and one free group was formed. The groups of the second statistical course used the Studynet CSCL environment as well. Here too, email and telephone were prohibited.

**Procedure**

VEC lasted 14 weeks, in which there were three face-to-face meetings, namely, a launch meeting at the start of the course, an evaluation meeting halfway through the course, and a closing meeting at the end of the course. The questionnaire including all the measures was administered electronically (using Dipolar Professional Quest software, release 2.2, http://www.dipolar.com.au) just after the second face-to-face meeting. From the total of 35 students only 11 students (31.4 %) responded to the questionnaire, from which 9 students (25.7 %) responded to all items. Stat 1 lasted 18 weeks, in which three face-to-face meetings were organized. The same electronic questionnaire was used. From the number of students that actually participated (26 students; 38 initial students less two non-starters and 10 drop-outs), 18 (69.2 %) students responded to the questionnaire. Stat 2 had a variable length. Slow and free groups had 10 months to complete the course while fast groups had six. At the time of the data collection, slow and free groups were still studying while the fast groups had completed the course. From the number of students that actually participated (93 students; 113 initial students less six non-starters and 14 drop-outs), 50 (53.8 %) students responded. Two students who dropped out also returned the questionnaire. The total number of respondents was, therefore, 52.

**Instruments**

In order to validate the Sociability Scale, the Social Presence Scale, and the Social Space Scale, four instruments dealing with constructs related to sociability, social presence, and social space – or to aspects of them – were selected as reference measures:

1. **Social Presence Indicators** (Gunawardena, 1995). This questionnaire consisted of 17 five-point bipolar scale items to assess a range of feelings students have towards CMC. Here, we refer to these bi-polar scale items as the Social Presence Indicators. In our study, we have translated these items into Dutch.

2. **Social Presence Scale** (Gunawardena & Zittle, 1997). This Social Presence Scale (from here on referred to as the GZ Social Presence Scale to avoid confusion with our Social Presence Scale) is, according to Gunawardena & Zittle, an alternative scale for measuring social presence which can be used interchangeably with the Social Presence Indicators. The GZ Social Presence Scale consists
of 14 five-point Likert-scale items. In our study, we did not consider three items because these test items require comparison of CMC with, respectively, face-to-face, audio teleconference, and video teleconference with regard to the impersonality of discussions. We also slightly adapted the GZ Social Presence Scale of better fit our particular setting and translated it into Dutch.

(3) Work-Group Cohesiveness Index (Price & Mueller, 1986). This index aims to measure work-group cohesion in an organizational context. It consists of 5 five-point Likert scale items. All items were translated into Dutch.

(4) Group Atmosphere Scale (Fiedler, 1962). This scale consists of 9 eight-point bipolar items for assessing the atmosphere in a group as perceived by the group. Instead of using eight-point scales we used five-point scales to concur with the other scales used. All items were translated into Dutch.

For validation we used Campbell & Fiske’s (1959) criterion that related constructs in a nomological network (Cronbach & Meehl, 1955) should exhibit moderate to high correlations, but not too high since extreme correlation could be interpreted as equivalency.

Our expectations with regard to the correlations between the scales involved are summarized in Table IV.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Sociability Scale</th>
<th>Social Presence Scale</th>
<th>Social Space Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Presence Indicators</td>
<td>high</td>
<td>moderate</td>
<td>low/moderate</td>
</tr>
<tr>
<td>GZ Social Presence Scale</td>
<td>high</td>
<td>moderate</td>
<td>cannot predict</td>
</tr>
<tr>
<td>Work Group Cohesion Index</td>
<td>moderate</td>
<td>moderate</td>
<td>high</td>
</tr>
<tr>
<td>Group Atmosphere Scale</td>
<td>moderate/high</td>
<td>moderate</td>
<td>low/moderate</td>
</tr>
</tbody>
</table>

Table IV. Summary of the expected correlations between the scales.

Refinement of the Scales

The raw Social Space Scale contained 44 initial test items and was refined in the following four steps. In the first step, a factor analysis (Principal Component Analysis, Varimax rotation) was performed on these test items and all other items of the questionnaire encompassing all the other scales. The majority of initial test items of the raw Social Space Scale loaded higher than .40 exclusively on factor two or three. This means that the social space construct is not one-dimensional but two-dimensional. These two factors are interpreted as Positive Group Behaviour (factor two) and Negative Group Behaviour (factor three) and can be considered as dimensions of the social space construct. In this step, test items were also removed in case of a load on the two factors of less than .40 (five items), or in case of a load higher on the other factors than on the two factors (two items). The second step was a careful semantic examination of the items. Test items that show similarities with or were (semantically) identical to items on the other scales were removed (11 items). The third step was removal of test items not associated with positive or negative group behaviour (four items), or that were almost (semantically) identical to another item within the raw Social Space Scale (one item). The fourth and final step was aimed at balancing the items in the dimensions Positive Group Behaviour and Negative Group Behaviour with no more than 10 items in each dimension (removed one item). The refined Social Space Scale is depicted in Table I. With respect to the loadings, a new factor analysis (Principal Component Analysis using Varimax rotation) was performed on the final 20 test items thereby focusing on a two-factor solution. Both factors show strong loadings. The two factor solution explained 54.59% of the total variance (the first factor explained 30.14% and the second factor 24.45%).

The raw Sociability Scale was refined in three steps. In the first step, 24 items from the 34 initial test items were removed because they either addressed a utility (i.e. a feature) or usability (is it easy-to-use?) aspect rather then a sociability aspect. Therefore, we decided not to include these items in the Sociability Scale. In the second step, a factor analysis (Principal Component Analysis, no rotation) was performed on the remaining test items. This step revealed that the Sociability Scale is one-dimensional (using the scree test of Catell, 1966). The step was also used to remove the few test items that did not load higher than .40 (see for this criterion, Stevens, 1992) exclusively on the first factor (removed zero items). The third and last step was to reduce the remaining test items
further to 10 without losing too much of explained total variance (removed zero items, we already had 10 items). The resulting refined Sociability Scale is depicted in Table II. The three last columns show respectively mean (M), standard deviation (SD), and loading on the first and only factor (a new factor analysis [Principal Component Analysis, no rotation] was performed on the 10 final test items). The factor explained 58.52% of the total variance.

The raw Social Presence Scale initially consisted of eight test items which we reduced to five items. Our objective was to derive a one-dimensional measure (the screeplot suggested this dimensionality). Items (two items) were removed that did not directly assess the psychological sensation associated with social presence. Factor analysis (Principal Component Analysis, no rotation) on the remaining six test items revealed two factors, one item loaded equally strongly on both factors; this item was removed. Table III depicts the refined Social Presence Scale. A second factor analysis (Principal Component Analysis, no rotation) was performed on the five test items of the refined scale to obtain the factor loadings on the first and only factor. The factor explained 57.17% of the total variance.

**Results**

**Internal Consistency and Validity of the Scales**

Cronbach’s alphas for the Sociability Scale and the Social Presence Scale are respectively .92 and .81 revealing a high internal consistency for both scales. Cronbach’s alpha for the Social Space Scale is .91; Cronbach’s alphas for the Positive Group Behaviour dimension and the Negative Group Behaviour dimension are respectively .92 and .87. These values show that the Social Space Scale has a high internal consistency as well. The content validity of the scales was established via face-validity. The items were developed based upon a search in the literature regarding social interaction via CMC, group development and group dynamics, social presence, trust building, and creating sense of community.

**Pearson Bivariate Correlations**

First we applied a Pearson bivariate correlation (2-tailed) analysis on the aggregate scores of the test items of the different scales involving Sociability Scale, Social Presence Scale, and Social Space Scale on the one-hand, and each of the measures Social Presence Indicators, GZ Social Presence Scale, Work Group Cohesion Index, and Group Atmosphere Scale on the other hand.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Sociability Scale</th>
<th>Social Presence Scale</th>
<th>Social Space Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Positive Group Behaviour</td>
<td>Negative Group Behaviour</td>
</tr>
<tr>
<td>Social Presence Indicators</td>
<td>.83**</td>
<td>.58**</td>
<td>.01*</td>
</tr>
<tr>
<td>GZ Social Presence Scale</td>
<td>.85**</td>
<td>.62**</td>
<td>.01*</td>
</tr>
<tr>
<td>Work Group Cohesion Index</td>
<td>.60**</td>
<td>.70**</td>
<td>.28*</td>
</tr>
<tr>
<td>Group Atmosphere Scale</td>
<td>.78**</td>
<td>.55**</td>
<td>.12*</td>
</tr>
</tbody>
</table>

Table V: Pearson bivariate correlation coefficients between the different scales.

**p < .01, 2-tailed. *p < .05, 2-tailed.

As can be seen in Table V, correlations are, both with respect to strength and the direction, as expected. The correlations between the Social Presence Indicators and the Negative Group Behaviour dimension of the Social Space Scale and between the GZ Social Presence Scale and the Negative Group Behaviour dimension of the Social Space Scale appear to be respectively .01 and .01. This means that there is no relationship between the corresponding variables. The correlations show that the Sociability Scale, Social Presence Scale, and the Social Space Scale are indeed measuring phenomena that are related to sociability, social presence, social space, group cohesiveness and group atmosphere.
Principal Component Analysis Using Varimax Rotation

We also applied factor analysis (Principal Component Analysis using Varimax rotation) on all the test items of the scales. We restricted the extraction to only four factors because the purpose of this analysis was not to reveal factors, but rather to confirm the uniqueness of the scales with respect to each other. Because the Social Space Scale has two dimensions and the Sociability Scale as well as the Social Presence scale only one, the restriction was set to four. The result of this analysis shows that each of the three scales indeed measure a separate phenomenon.

Discussion

Before discussing the implications it has to be stressed that the research presented here only provides a rather limited basis for the validation of the three scales; the number of subjects involved was relatively small. It is therefore urged that additional research is carried out to provide a more solid basis for the scales. Moreover, if larger groups of participants are involved, it becomes easier to analyze the effect of variables like group size and degree of pre-structuring on perceived quality of social interaction. In addition, the diversity in CSCL environments used by the participants involved has to be taken into consideration to avoid the scales being biased for specific types of environments. Finally, it would be interesting to analyze the results not only on the level of the individual subject, but also on the group level. Despite the fact that the scales ask for individual opinions and perceptions, the subjects are interacting in a group, so the group could also be considered to be a unit of analysis (cf. Strijbos et al, 2004b).

The central tenet in this contribution is the notion that interaction has to be designed as it will not automatically emerge given a specific CSCL environment and task to be performed. The framework we have described is a plea for a systematic approach for group-based learning design so as to draw out the desired type of interaction amongst the group members by paying attention to the five critical elements that affect interaction. From this point of view, sociability as a characteristic of a CSCL environment is just one of the relevant dimensions that has to be taken into account. However, it is clear that striving for sociability only is not sufficient for arriving at the desired interaction in a distributed learning group. Additional measures are needed that affect the other dimensions that have been mentioned before. We refer to the research on providing functional roles and stimulating reflection in distributed groups indicating that these types of measures influence at least the perception of group processes and thus the appreciation. The findings also indicate that a sound social space is not a target in itself; it is just a means for arriving at the interaction desired.

From this perspective, the importance of the scales is that they allow designers and teachers to analyse whether the quality of interaction in computer-supported group-based learning is adequate or not with respect to the aspects social space, social presence and sociability. If not, they have to take measures in order to arrive at a more satisfying quality.

The scales as such do not provide guidelines for improving; they just help to make visible certain characteristics of distributed interaction. As such, they provide a base for research on interaction in computer-supported group-based learning. This might lead in the longer run to guidelines for designers of CSCL.

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References


Measuring Social Aspects of Distributed Learning Groups


