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PRESCRIPTIVE GUIDELINES FOR WHEN TO USE SYNCHRONOUS COMMUNICATION IN E-LEARNING ENVIRONMENTS

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Abstract

It is commonly argued that asynchronous computer-mediated communication (CMC) is preferable for promoting reflection and discussing complex ideas in e-learning environments. However, guidelines for when to use synchronous media are unavailable. In order to address this problem, we propose initial prescriptive guidelines for when to support synchronous communication, as a complement to asynchronous communication, in e-learning environments. The guidelines are theoretically grounded as well as empirically grounded through a series of studies on synchronous CMC in e-learning settings conducted between 2003 and 2006. Nevertheless, the guidelines can also be considered to be research hypotheses since they can be tested and further developed in future research. It is acknowledged that the guidelines proposed here can, however, only be hypothesized to be useful until they have undergone thorough evaluation.

Keywords: E-learning, E-education, Computer-mediated communication, Information sharing, E-collaboration, Design science.

1 INTRODUCTION

E-learning is an important area for the information systems (IS) community since more research will be needed to face the emerging knowledge society, in which the need for life-long learning is emphasized (Alavi & Leidner 2001). The need for education has dramatically changed because of a demand for a highly educated workforce who will be expected to learn continuously. However, Alavi and Leidner (2001) argue that there is “a paucity of theoretically grounded and rigorous research to guide the development of [e-learning] environments” (p. 2). There is thus a need to develop theories to support the design and implementation of such environments “as they are complex and incorporate a variety of organisational, administrative, instructional and technological components” (Jones & Gregor 2006, p. 356). Preferably, such theories are formulated in a way that practitioners, for example, teachers, managers and designers of e-learning systems, find useful. To increase utilization and relevance, mainstream IS research, which is based on behavioural science, can preferably be complemented with research based on design science (van Aken 2004, Venable 2006).

There is increased pressure on teachers to incorporate technology, such as CMC, in order to support more active learning. Schullo et al. (2005) argue that there is a need to develop prescriptive guidelines since they have the potential to guide teachers and developers of e-learning environments who are considering using or implementing synchronous media. The need of support is becoming increasingly urgent as the use of CMC continues to grow in higher education settings (Olaniran 2006). This has led to calls for prescriptive and practical guidelines. Examples of such research efforts include Haythornthwaite’s (2006) recommendations on how to facilitate collaboration in e-learning and Olaniran’s (2006) suggestions for how synchronous CMC may be used as a supplement in traditional education. However, guidelines for practitioners interested in using synchronous media, as a complement to asynchronous e-learning, are still unavailable.

In this paper, the lack of guidelines is addressed by proposing five prescriptive guidelines, for when to support synchronous media as a complement to asynchronous e-learning environments. The prescriptive guidelines were developed through an iterative process comprising literature reviews (theoretical grounding) and a series of empirical studies (empirical grounding) conducted between 2003 and 2006. The guidelines are expected to contribute to practice by guiding practitioners in deciding when the use of synchronous media may be appropriate. This paper is also a contribution to research since the guidelines can be tested and developed in future research (Markus et al. 2002).

The paper is structured as follows: First, a series of studies on which the prescriptive guidelines were empirically grounded are described. Then, we present a background to how prescriptive guidelines can be developed. This is followed by a description and motivation of the guidelines. Finally, conclusions, limitations and suggestions for further research are put forth.

2 A SUMMARY OF OUR RESEARCH ON SYNCHRONOUS COMMUNICATION

During recent years, we have been involved in a series of studies on CMC in e-learning settings. The studies were naturalistic evaluations and are retrospectively analysed in this paper in order to formulate prescriptive guidelines. More specifically, the purpose of the studies has been to examine how the use of synchronous media, as a complement to asynchronous ones, affects participation in e-learning environments. In the first phase, the focus was on informal use of synchronous media while the second phase focused on formal use of synchronous media. In the studies, participation was defined as “a process of taking part and ... the relations with others that reflect this process” (Wenger 1998, p. 55). Researchers seem to have reached consensus that participating by interacting with others positively affects learning in both traditional and e-learning settings (Leidner & Jarvenpaa 1995). In fact, major empirical studies on e-learning in higher education have confirmed that active participation drives learning (Hiltz et al. 2000). In these studies, learning has been measured as perceived learning, grades and quality assessment of assignments. Furthermore, it has

been argued that participation positively influences student satisfaction (Alavi & Dufner 2005) and retention rates (Rovai 2002). The decision to focus on participation gave us in-depth understanding of the relationship between synchronous media and participation. However, a weakness of this approach is a limited understanding of other variables, such as the effectiveness of communication.

2.1 Studies on informal use of synchronous media

The first phase includes a series of studies on an undergraduate online course in business English. It has traditionally been delivered asynchronously but to try to make it simpler for students to communicate with each other, without having to wait too long for answers, an Instant Messaging (IM) system was introduced. IM is a synchronous medium that can be used to communicate with people on a list of “friends”. IM fulfils Fish et al.’s (1990) criteria for informal communication media: (a) access to a suitable population of others; (b) an environmental mechanism that brings people together; (c) the effort needed to initiate and conduct a conversation should be low; and (d) a visual channel.

Three comparative studies that were guided by the following research question were carried out: How does the possibility to communicate synchronously via IM affect student participation? First, two project groups that adopted IM were compared with two groups that did not (Hrastinski 2006b). Second, students enrolled in 2004 that were characterized as adopters were compared with non-adopters (Hrastinski 2006a). Third, the 2003 offering of the course (n=16), where IM was not used was compared with the 2004 offering (n=14) where IM was used (Hrastinski 2006a). The comparisons were based on several data collection methods, which are summarized in Table 1. The first comparison used diaries, questionnaires and interviews, while the second and third comparisons relied on questionnaires and interviews.

In sum, the findings revealed that when comparing students and groups that adopted IM with those that did not, it was found that the adopters were related with a higher level of perceived participation, were characterized by slightly denser social networks and spent more time working with content and communicating with peers. Notably, the third comparison did not support these findings. Instead, it was found that the 2003 class, where IM was not used, was characterised by denser social networks and a higher level of perceived participation. However, since different groups of students were compared, other variables, such as student attitudes towards online collaboration and synchronous media, might have affected participation.

Study	Time period	Data collection	Purpose
1.3	Jun-Aug 04	Questionnaire	Collect data on perceived participation and social networks in the 2003 class.
1.1	Nov 04	Diary	Collect data on social networks during two weeks when students of the 2004 class worked with a group project.
1.1	Dec 04	Questionnaire	Collect data on perceived participation in relation with the group project of the 2004 class.
1.2, 1.3	Jan-Feb 05	Questionnaire	Collect data on perceived participation and social networks of the 2004 class.
1.1, 1.2, 1.3	Jan-Feb 05	Interviews	Obtain a richer view of how IM was used as compared with other media in the 2004 class.

Table 1. *The process of data collection in the first phase*

2.2 Studies on formal use of synchronous media

In the second phase, two series of online discussion with master students on knowledge management were studied (n=8, n=19). The first case setting is a series of online discussions with Argentinean and Swedish students (Hrastinski in press). Students from the two countries participated in two asynchronous and two synchronous online discussions over a two-week period. The second case

setting is an online course on change and knowledge management (Keller & Hrastinski 2006). The main teaching method of the course was asynchronous and synchronous online discussions.

The studies were guided by the following research question: How does the use of synchronous chat, as a complement to asynchronous discussion board, affect student participation? Both series of discussions were used to compare participation by synchronous chat and asynchronous discussion board. The data collection methods are summarized in Table 2. Questionnaires were used to collect data on perceived participation and electronic logs were used to collect data on actual participation. Four interviews were carried out following the first series of online discussions and eight interviews following the second series of online discussions.

In sum, the results indicated that using synchronous chat has the potential to affect participation positively in online discussions. The students of both the first and second comparison contributed more and reported stronger perceived participation in the synchronous discussions, especially in the smaller class. In the synchronous discussions, students did not feel restricted to only discussing course content, which may explain why these discussions were related with a higher level of participation. Notably, the third comparison did not support these findings. Instead, the students reported slightly stronger perceived participation in the asynchronous discussions, when being asked after the course was finished. A tentative explanation for this finding is provided in section 4.2.

Study	Time period	Data collection	Purpose
2.1, 2.2	Apr-May 05, Oct-Nov 05	Questionnaires	Collect data on perceived participation following each online discussion.
2.1, 2.2	Apr-May 05, Oct-Nov 05	Electronic logs	Collect data on actual participation in following each online discussion.
2.1, 2.2	Jun, Aug 05, Nov-Dec 05	Interviews	Gain a deeper understanding of perceived participation after all online discussions were finished.
2.3	Jan 06	Questionnaires	Collect data on perceived participation after all online discussions of the second case were finished.

Table 2. *The process of data collection in the second phase*

3 DEVELOPING PRESCRIPTIVE GUIDELINES FOR IS USE

E-learning research should not only be rigorous but also need to address the utilization and relevance problem of current research (Hirschheim & Klein 2003). To increase utilization and relevance, mainstream IS research, which is based on behavioural science, can preferably be complemented with research based on design science (van Aken 2004, Venable 2006). In a review of influential IS design research frameworks (Hevner et al. 2004, March & Smith 1995, Walls et al. 1992), Carlsson (2006) concludes that the reviewed frameworks focus on the IT artefact per se while leaving out people and organizations. However, Simon's (1988) view on design science is that it can be more than IT artefact design knowledge that the IS field should develop: "Everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (1988, p. 129). Carlsson (2006) suggests that the aim of IS design science research should be to develop practical knowledge for the design and improvement of IS and IS use. In this paper, we focus on developing prescriptive guidelines for IS use, i.e. when to support synchronous media as a complement to asynchronous e-learning environments.

A process for developing prescriptive guidelines is suggested in Figure 1. The starting point is a practical problem. For example, an organization may want guidance on how to make "an e-learning initiative lead to desired learning outcomes". This is the first step in developing prescriptive guidelines and means that one tries to generate guidelines by continuously interacting with what is currently known, that is, grounding in kernel theories and previous research. Gregor (2006) maintains that "knowledge of people and information technology capabilities informs the design and development of new information systems artefacts" (p. 629). Moreover, she argues that design theory, and explanatory and predictive theory, are strongly interrelated. We drew upon social theory of learning (Vygotsky

1978, Wenger 1998) and the cognitive model of media choice (Robert & Dennis 2005) as kernel theories, our previous research on CMC in e-learning settings, and findings from similar studies. Thus, as suggested by Gregor, we let both kernel theories and findings from previous explanatory and predictive research guide our work.

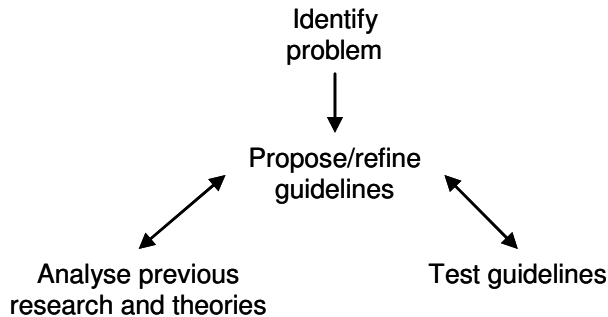


Figure 1. Developing prescriptive guidelines

Eventually, initial prescriptive guidelines were formulated. The purpose was to develop abstract knowledge rather than recipes. Practitioners are suggested to design based on her/his experience, the specific problem situation and context, and on the knowledge of the guidelines (Carlsson 2006, van Aken 2004). Prescriptive guidelines can also be considered to be research hypotheses since they can be tested and further developed in future research (Markus et al. 2002). The next step is empirical tests of the guidelines, which includes the selection of appropriate data collection methods. In this step it is studied whether the prescriptive guidelines may be used as support when trying to “change” reality. Based on the results, it may be reflected on the outcome and the guidelines may be refined. Through multiple studies one can accumulate supporting evidence iteratively and continuously move towards “theoretical saturation”. This paper is limited to proposing theoretically and empirically grounded prescriptive guidelines that will be tested in further research.

4 PRESCRIPTIVE GUIDELINES

In this section, prescriptive guidelines for when to use synchronous communication in e-learning settings are proposed. Inspired by Gregor (2006), we summarize the rationale of the guidelines in Table 3. In our studies, we have learnt that the relationship between synchronous communication and participation is complex and by drawing on the studies summarized above, we have come to the following conclusion: “Supporting synchronous communication has the potential to enhance participation in e-learning settings”. The next step from this conclusion is to study the relationship between synchronous communication and participation more thoroughly to reveal when, i.e. in what circumstances, synchronous communication may enhance participation in e-learning settings.

Overview	Five prescriptive guidelines designed for practitioners, to support decisions on when to use synchronous communication in e-learning environments.
Primary constructs	Perceived and actual measures of participation by asynchronous and synchronous media.
Statement of relationships	Design for student participation by using synchronous means of communication, that is, synchronous communication has the potential to enhance participation.
Scope	E-learning environments that support both asynchronous and synchronous means of communication.
Causal explanations	Kernel theories that underlie the guidelines include social theories of learning (e.g., Vygotsky 1978, Wenger 1998) and the cognitive model of media choice (Robert & Dennis 2005). An assumption is that it is desirable to strive towards achieving a high level of participation to enhance learning in e-learning environments.
Testable propositions	These are initial guidelines that may be continuously tested and improved through empirical and theoretical grounding.

Table 3. The rationale of the prescriptive guidelines (adapted from Gregor 2006)

4.1 Guideline #1: Synchronous communication may enhance participation, especially in smaller groups

Study 1.1 revealed that two out of four project groups chose to communicate synchronously by IM. Project groups that were characterized as adopters were related with a higher level of participation when compared with non-adopters. The adopters used IM as a complement to rather than replacement of e-mail.

A comparison of study 2.1 (smaller class) and study 2.2 (larger class) indicates that using synchronous media may especially enhance participation in smaller groups. Figure 2 illustrates that social networks were denser when communicating synchronously in the smaller class, while the difference in network density was small in the larger class. Differences of means for perceived participation between the two types of media are presented in Table 4. It difference in means achieved statistically significant for the smaller class (χ^2 (d.f. = 4) = 19.0, p = .001) but just reached the critical value (14.9) for chi-square distributions for the larger class (χ^2 (d.f. = 4) = 14.9, p = .005). One of the items of the measure revealed that the students of the smaller class especially felt more connected to others when using the synchronous medium (item 8). These findings are also supported by the number of written sentences, which shows that the students of the smaller class wrote four times as many sentences in the synchronous discussions while the difference was much smaller in the larger class (see Table 5).

Our findings are supported by previous research. According to Palloff and Pratt (1999), the “critical mass” (Markus 1987) needed to get discussions going in synchronous settings is lower. They argue that an ideal class size for synchronous classes are less than ten students, while asynchronous classes preferably should include twenty or more students. The cognitive model of media choice states that high numbers of students in synchronous discussions lead to confusion, and thus, decreased participation. The model predicts that synchronous communication enables monitoring the receiver’s reaction to a message, which makes the receiver more committed to read and respond to the message (Robert & Dennis 2005). Thus, including a high number of students in synchronous discussions, can lead to confusion since many students may respond to many messages simultaneously. It then becomes unmanageable to know who is answering what to whom (Contreras-Castillo et al. 2006) and, logically, this issue is of more concern in larger groups.

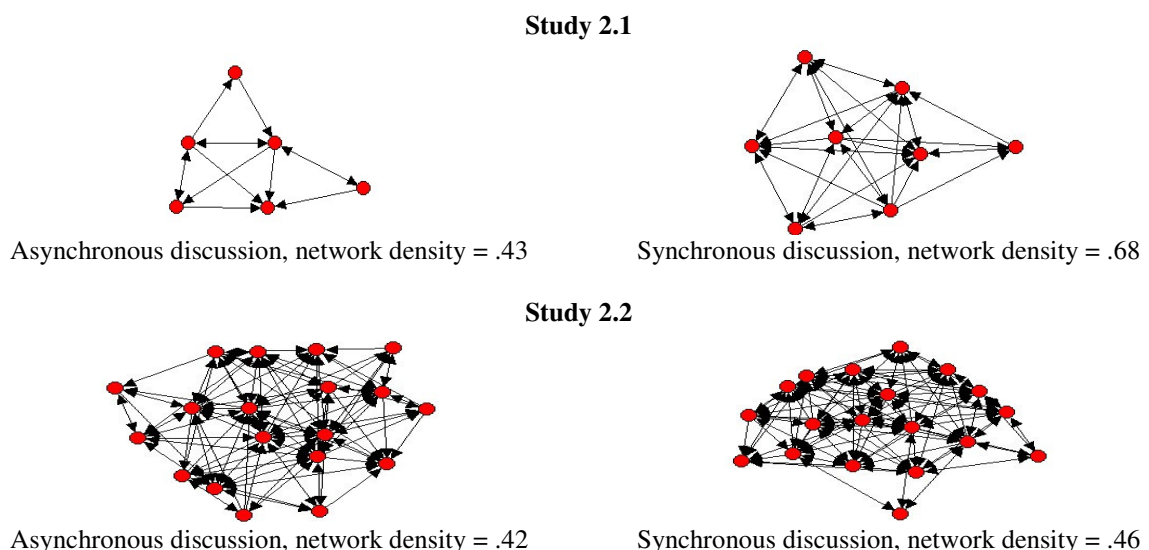


Figure 2. Sociograms illustrating whom students perceived they had communicated with when using the asynchronous medium (left) and synchronous medium (right). The sociograms were created with Ucinet 6 (Borgattiet al. 2002).

	Study 2.1				Study 2.2			
	Synchronous (n=13)		Asynchronous (n=11)		Synchronous (n=31)		Asynchronous (n=32)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. I felt like the participants in the discussion worked together.	4.0	0.8	3.5	1.4	4.0	1.0	3.8	0.9
2. I felt that the discussion included social interaction.	3.8	1.1	2.9	1.6	3.8	1.0	3.5	1.0
3. As a student, I felt part of the discussion.	4.4	0.5	3.9	0.8	4.2	0.7	4.0	0.8
4. I felt comfortable interacting with participant(s).	4.3	0.6	3.7	1.3	3.8	1.0	4.0	0.4
5. As a student, I felt personally involved in the discussion.	4.4	0.5	4.3	0.5	4.1	0.6	3.9	0.8
6. I felt that my point of view was acknowledged by others in the discussion.	4.3	0.5	3.9	1.1	4.0	0.7	3.9	0.7
7. I felt that students in the discussion cared about each others' opinions.	4.2	0.4	3.8	1.0	4.0	0.9	4.0	0.6
8. I felt connected to the others in the discussion.	4.2	0.6	3.4	1.1	4.0	0.8	3.9	0.6
Total	4.2	0.7	3.7	1.2	4.0	0.9	3.9	0.8

Table 4. Perceived participation in synchronous and asynchronous discussions on a five-point ordinal scale for study 2.1 and 2.2

	Study 2.1				Study 2.2			
	Synchronous		Asynchronous		Synchronous		Asynchronous	
	n/stud.	SD	n/stud.	SD	n/stud.	SD	n/stud.	SD
Information exchange	54	17	20	15	51	18	59	35
Task support	18	6	0	0	23	7	2	2
Social support	13	9	0	0	15	10	3	3
Sentences	86	30	20	15	84	26	62	36

Table 5. Mean number of sentences per student and standard deviations for study 2.1 and 2.2

4.2 Guideline #2: Synchronous communication may enable “personal” participation

A comparison of study 2.2 and 2.3 reveals that perceived participation changes over time (see Table 6). In the second phase, we collected data on perceived participation just after two asynchronous and two synchronous discussions had been completed (study 2.2), and after the course was finished (study 2.3). Note that the numbers of respondents differ because the students of study 2.2 were asked to complete questionnaires following each of the two synchronous and two asynchronous discussions. Table 6 shows that the means for most items were higher for synchronous communication, when students were asked directly after the discussions, compared to when they were asked retrospectively. The decrease in the level of perceived participation was found to be significant for both synchronous (χ^2 (d.f. = 4) = 43.4, $p < .001$) and asynchronous communication (χ^2 (d.f. = 4) = 63.1, $p < .001$). Students felt that they participated to a lower extent when asked retrospectively. Notably, this finding is especially evident for the synchronous discussions, where the mean for perceived participation dropped from 4.0 to 3.4.

The cognitive model of media choice predicts that receivers are more committed to read and respond to messages when communicating synchronously (Robert & Dennis 2005). Similarly, Mason (1998) argues that synchronous communication helps focusing the energy of the group and provides motivation for students to keep up with their peers. This may explain why students maintained denser interpersonal networks by synchronous media. The cognitive model of media choice also predicts that students respond quickly by synchronous media since they do not want to disrupt the conversation.

Directly after the synchronous discussions, the level of perceived participation was high, which at least partly can be explained by that the students felt part of a more intense and motivating experience (Robert & Dennis 2005). However, after having more time to reflect on the discussions, the students seemed to realize the more subtle benefits of asynchronous discussions such as “taking part of other students reflections and analysis of the literature”, “time to think about your own and others’ postings” and “the possibility to do research before posting” (Study 2.3, Open-ended questionnaire).

We introduce the concepts of *personal participation* to describe the more intense type of participation supported by synchronous communication and *cognitive participation* to describe the more reflective type of participation supported by asynchronous communication. Synchronous personal participation seems to better support less complex information exchanges, including task support and social support exchanges, while asynchronous cognitive participation seems to better support reflection and discussion of complex ideas.

	Study 2.2				Study 2.3			
	Synchronous (n=31)		Asynchronous (n=32)		Synchronous (n=17)		Asynchronous (n=17)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. I felt like the participants in the discussion(s) worked together.	4.0	1.0	3.8	0.9	3.5	1.0	3.7	0.9
2. I felt that the discussion(s) included social interaction.	3.8	1.0	3.5	1.0	3.2	1.2	3.1	0.8
3. As a student, I felt part of the discussion(s).	4.2	0.7	4.0	0.8	3.7	1.0	4.1	0.9
4. I felt comfortable interacting with participant(s).	3.8	1.0	4.0	0.4	3.5	1.4	4.0	1.0
5. As a student, I felt personally involved in the discussion(s).	4.1	0.6	3.9	0.8	3.4	1.1	3.7	1.1
6. I felt that my point of view was acknowledged by others in the discussion(s).	4.0	0.7	3.9	0.7	3.4	1.0	3.5	1.0
7. I felt that students in the discussion(s) cared about each others’ opinions.	4.0	0.9	4.0	0.6	3.5	1.1	3.7	0.9
8. I felt connected to the others in the discussion(s).	4.0	0.8	3.9	0.6	3.4	1.2	3.6	1.0
Total	4.0	0.9	3.9	0.8	3.4	1.1	3.7	1.0

Table 6. Perceived participation in synchronous and asynchronous discussions on a five-point ordinal scale for study 2.2 and 2.3

4.3 Guideline #3: Synchronous communication may be useful as support for task support exchanges

The studies of both phases have showed that students spend more time exchanging task support when using a synchronous medium. This seems to be a contributing factor in enhancing participation since it helps students feel that they are working together. The students that chose to use a synchronous medium (IM) to support group work primarily used it when maintaining task support exchanges (study 1.1). However, when exchanging information they preferred using e-mail.

The content analyses from the studies of the second phase indicate that the use of synchronous chat, as compared with asynchronous discussion board, was characterized by a higher relative degree of task support exchanges. In synchronous discussions, students had to decide what to discuss, and how to sum up and present the results of their discussion within a specific time period. This explains the high frequency of task support exchanges, which varied between 18 and 23 sentences per student. However, the corresponding frequency of task support exchanges when using an asynchronous medium was

between 0 and 2 sentences per student (see Table 5). Malmberg (2006) presents evidence that supports this guideline. He found that self-organizing groups of students, who had access to both discussion board and chat, chose the latter to support task support relations.

4.4 Guideline #4: Synchronous communication may enable social support relations

The studies of the first phase found that students rarely felt that they exchanged social support. The only exception was among some of the students that adopted a synchronous medium (IM) to support group work. This underlines that synchronous media will not, by default, be used for social exchanges.

Social support exchanges were more common in the studies of the second phase. In these studies it was showed that communicating synchronously led to a higher relative degree of social support exchanges. Such exchanges accounted for between 13 and 15 sentences per student, while the asynchronous discussions included 0 to 3 such sentences per student (see Table 5). Study 2.3 revealed that students especially appreciated immediate feedback and social presence in the synchronous discussions. It should, however, be noted that both sentence counts per student and the second item of the measure on perceived participation (see Table 4, 5 and 6) were related with high standard deviations which tells us that some students exchanged social support frequently, while others chose not to engage in such exchanges. There are probably many factors that affect why some students thrived in the more social synchronous environment while others did not. A prominent factor that was identified in study 2.3 was age. In general, older students felt that synchronous discussions included social interaction (item 2) to a lower extent. Moreover, significant negative relationships were identified between age and the third, fourth, sixth and eight items (see Table 6).

In line with the results of Orvis and colleagues (2002), exchanges of social support followed temporal patterns. Social interaction usually occurred in the beginning and end of class and in between group discussions. Both classes followed a tight schedule, which may be one reason for a lower level of social support compared with some previous studies. For example, Chou (2002) classified 33% of examined sentences as socioemotional in an upper-level undergraduate course and Orvis and colleagues (2002) classified 30% of chat lines as social in online military training.

4.5 Guideline #5: Synchronous communication may be used to enable both class-wide and group-wide relations

In our studies we have learnt that the use of synchronous media should not be restricted to a specific activity. Synchronous media may tempt teachers to try to emulate their “traditional habits of face-to-face instructions”, such as lecturing, instead of looking for opportunities to improve the quality of e-learning (Kinshuk & Chen 2006). We will give an example, which illustrate that synchronous media can not only support traditional “formal” activities but also more innovative and “informal” dimensions.

IM is an example of a medium that seems appropriate for supporting informal communication (Contreras-Castillo et al. 2004), which was examined in the studies of the first phase. The IM system was associated with an introductory activity that was mandatory. During the remaining course, using the IM system was voluntarily. About half of the students and project groups adopted IM. However, some were so determined to work individually that they did not care if the teacher encouraged communication among them. During the end of the course the students were asked to submit a questionnaire that investigated whom they had communicated with by IM (see Figure 3). The letter of each node denotes which project group each student belonged to – there were four groups (A-D). The figure illustrates that the students mainly used IM to communicate with their group members. This differs from the synchronous discussions of the second phase, where students maintained weak ties with many peers.

In most cases the discussions that occurred by IM were unscheduled. The system was used to enable student-organized meetings, and optional opportunities for communication. Usually, students would

not have an agenda, but instead spontaneously began communicating. Some students reported that they not only discussed class work but also exchanged social and emotional support. In sum, this seems to be an example of informal group-wide communication, at least when compared with the previous example.



Example 1: Chat discussion, network density = .46

Example 2: IM, network density = .17

Figure 3. Social networks of students when using chat (left) and IM (right)

Interestingly, this guideline coincide with a guideline that has been proposed by Haythornthwaite (2006): “Provide both public and private means of communication: balance the public and the private so not all communications at all times are recorded for public review, and/or allow places and spaces for informal, non-recorded online conversation” (p. 17). Students use the private means of communication “to ask for help they would not otherwise ask for before the whole class” (Haythornthwaite 2006, p. 16). Scardamalia and Bereiter (1996) present similar advice and also add that it is also important to make private discussions possible in order to prevent that class-wide discussions are filled with irrelevant or boring information. Some may worry that introducing new media may lead to displacement effects of existing and more “important” media. However, research has found that strongly tied students commonly use several media to communicate (Haythornthwaite 2006), which suggests that informal media are used as a complement to formal ones. For example, in our study, the students that used IM to support group-wide communication, used e-mail and discussion board as well.

5 CONCLUSIONS, LIMITATIONS AND FURTHER RESEARCH

In this paper, five initial prescriptive guidelines that may guide practitioners but, nevertheless, need to be tested and further developed in future research were proposed. They were formulated to support decisions on when to support synchronous communication, as a complement to asynchronous communication, in e-learning environments. We do not believe that it can be justified logically to propose *the* design theory of synchronous communication, which can predict how synchronous media should be appropriately used in specific situations. As acknowledged in section two, we argue that the output of design science research should be to develop abstract knowledge rather than recipes. Practitioners are suggested to design based on experience, the specific situation and context, and on the knowledge of the guidelines (Carlsson 2006, van Aken 2004).

The proposed guidelines can, however, only be hypothesized to be useful unless they are evaluated (Venable 2006). Our next research endeavour is to empirically test the guidelines proposed here. We plan to test and further develop the guidelines by asking for feedback from experienced teachers and managers, who use both asynchronous and synchronous media, in focus group sessions. Krueger (1994) argues that focus groups is an appropriate method for evaluating the effect of interventions in social contexts and, thus, seem appropriate for evaluating these guidelines. A limitation of the guidelines is that they are mainly based on research on text-based media. However, as more advanced synchronous software become available, audio and video media will become more widely used. In the focus group sessions, practitioners with experience of different types of media will be invited and hopefully these sessions will help us in further improving the guidelines.

References

- Alavi, M. and Dufner, D. (2005). Technology-mediated collaborative learning: A research perspective. In *Learning together online: Research on asynchronous learning networks* (Hiltz, S.R. and Goldman, R., Eds), pp. 191-213, Lawrence Erlbaum, Mahwah, New Jersey.
- Alavi, M. and Leidner, D.E. (2001). Research commentary: Technology-mediated learning - a call for greater depth and breadth of research. *Information Systems Research*, 12 (1), 1-10.
- Bento, R. and Schuster, C. (2003). Participation: The online challenge. In *Web-based education: Learning from experience* (Aggarwal, A., Ed), pp. 156-164, Idea Group Publishing, Hershey, PA.
- Borgatti, S.P., Everett, M.G., & Freeman, L.C. (2002). *Ucinet 6 for Windows: Software for social network analysis*. Analytic Technologies, Harvard.
- Carlsson, S.A. (2006). Towards an information systems design research framework: A critical realist perspective. In *Proceedings of the First International Conference on Design Science Research in Information Systems and Technology*, Claremont, CA.
- Chou, C.C. (2002). A comparative content analysis of student interaction in synchronous and asynchronous learning networks. In *Proceedings of the 35th International Conference on System Sciences*, Hawaii.
- Contreras-Castillo, J., Favela, J., Perez-Fragoso, C., & Santamaria-del-Angel, E. (2004). Informal interactions and their implications for online courses. *Computers & Education*, 42 (2), 149-168.
- Fish, R.S., Kraut, R.E. and Chalfonte, B.L. (1990). The VideoWindow system in informal communications. In *Proceedings of the Conference on Computer-Supported Cooperative Work*, Los Angeles.
- Gregor, S. (2006). The nature of theory in information systems. *MIS Quarterly*, 30 (3), 611-642.
- Haythornthwaite, C. (2006). Facilitating collaboration in online learning. *Journal of Asynchronous Learning Networks*, 10 (1), 7-24.
- Hevner, A.R., March, S.T., Park, J. and Ram, S. (2004). Design science in information systems research. *MIS Quarterly* 28, (1), 75-105.
- Hiltz, S.R., Coppola, N., Rotter, N., Turoff, M. and Benbunan-Fich, R. (2000). Measuring the importance of collaborative learning for the effectiveness of ALN: A multi-measure, multi-method approach. *Journal of Asynchronous Learning Networks*, 4 (2), 103-125.
- Hirschheim, R., & Klein, H.K. (2003). Crisis in the IS field? A critical reflection on the state of the discipline. *Journal of the Association for Information Systems*, 4 (5), 237-293.
- Hrastinski, S. (2006a). Introducing an informal synchronous medium in a distance learning course: How is participation affected? *Internet and Higher Education*, 9 (2), 117-131.
- Hrastinski, S. (2006b). The relationship between adopting a synchronous medium and participation in online group work: An explorative study. *Interactive Learning Environments*, 14 (2), 137-152.
- Hrastinski, S. (in press). Using chat as a complement to discussion board in small-group online seminars: How is student participation affected? *International Journal of Knowledge and Learning*.
- Jones, D. and Gregor, S. (2006). The formulation of an information systems design theory for e-learning. In *Proceedings of the First International Conference on Design Science Research in Information Systems and Technology*, Claremont, CA.
- Keller, C. and Hrastinski, S. (2006). Learning styles, age and perceptions of online discussions. In *Proceedings of the 5th European Conference on e-Learning*, Winchester.
- Kinshuk and Chen, N.S. (2006). Synchronous methods and applications in e-learning. *Campus-Wide Information Systems*, 23 (3).
- Krueger, R.A. (1994). *Focus groups: A practical guide for applied research*. Sage Publications , Thousand Oaks.
- Leidner, D.E. and Jarvenpaa, S.L. (1995). The use of information technology to enhance management school education: A theoretical view. *MIS Quarterly*, 19 (3), 265-291.
- Malmberg, C. (2006). *Kunskapsbygge på nätet: En studie av studenter i dialog (Knowledge construction on the web: A study of students in dialogue)*. PhD thesis, Malmö University, Malmö.

- March, S.T. and Smith, G. (1995). Design and natural science research on information technology. *Decision Support Systems*, 15 (4), 251-266.
- Markus, M.L. (1987). Toward a “critical mass” theory of interactive media: Universal access, interdependence and diffusion. *Communication Research*, 14 (5), 491-511.
- Markus, M.L., Majchrzak, A. and Gasser, L. (2002). A design theory for systems that support emergent knowledge processes. *MIS Quarterly*, 26 (3), 179-212.
- Mason, R. (1998). *Globalising education: Trends and applications*. Routledge, London.
- Olaniran, B.A. (2006). Applying synchronous computer-mediated communication into course design. *Campus-Wide Information Systems*, 23 (3), 210-220.
- Orvis, K.L., Wisher, R.A., Bonk, C.J., & Olson, T.M. (2002). Communication patterns during synchronous web-based military training in problem solving. *Computers in Human Behavior*, 18 (6), 783-795.
- Palloff, R.M. and Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom*. Jossey-Bass, San Francisco.
- Robert, L.P., & Dennis, A.R. (2005). Paradox of richness: A cognitive model of media choice. *IEEE Transactions on Professional Communication*, 48 (1), 10-21.
- Rovai, A. (2002). Building sense of community at a distance. *International Review of Research in Open and Distance Learning*, 3 (1), 1-16.
- Scardamalia, M., & Bereiter, C. (1996). Computer support for knowledge-building communities. In *CSSL: Theory and practice of an emerging paradigm* (Koschmann, T., Ed), pp. 249-268, Lawrence Erlbaum, Mahwah, New Jersey.
- Schullo, S., Venable, M., Barron, A.E., Kromrey, J.D., Hilbelink, A. and Hohlfeld, T. (2005). Enhancing online courses with synchronous software: An analysis of strategies and interactions. In *Proceedings of the National Educational Computing Conference*, Philadelphia, Pennsylvania.
- Simon, H. (1988). *The sciences of the artificial*. MIT Press, Cambridge, MA.
- Van Aken, J.E. (2004). Management research based on the paradigm of the design sciences: The quest for field-tested and grounded technological rules. *Journal of Management Studies*, 41 (2), 219-246.
- Venable, J. (2006). A framework for design science research activities. In *Proceedings of the Information Resource Management Association Conference*, Washington, DC.
- Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press, Cambridge, Massachusetts.
- Walls, J.G., Widemeyer, G.R. and El Sawy, O.A. (1992). Building an information systems design theory for vigilant EIS. *Information Systems Research*, 3 (1), 36-59.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press, Cambridge.