



Design exemplars for synchronous e-learning: A design theory approach

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ABSTRACT

Synchronous e-learning has received much less research attention, as compared with asynchronous e-learning. Practitioners that consider using and designing synchronous e-learning are in urgent need of guidance. In order to address this need, we propose design exemplars for synchronous e-learning. They are directed towards a primary constituent community of teachers, administrators, managers and developers of e-learning. The exemplars have been theoretically as well as empirically grounded through cross-case analyses of studies conducted between 2003 and 2006. Moreover, the exemplars have been evaluated by conducting focus group sessions with experienced practitioners having experience of using and developing e-learning. Strong support was identified for each design exemplar. The exemplars can be used as research hypotheses and be tested in future design research.

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1. Introduction

The adoption of computer-mediated communication (CMC) has resulted in refinements of previous definitions of distance education (Gunawardena & Mclsaac, 2004). For example, leading scholars in the field of distance education have considered CMC to be one of its defining characteristics for more than two decades (Garrison & Shale, 1987; Moore & Kearsley, 1996). This has led to the introduction of new terms, such as online education and e-learning, to describe new forms of distance education (Harasim, 1989). CMC offers new opportunities and goes beyond one-way transmission of content from teachers to learners and enables communication among human beings engaged in learning (Garrison & Anderson, 2003).

So far, most research has focused on asynchronous CMC, such as e-mail and discussion boards (Hrastinski & Keller, 2007; Romiszowski & Mason, 2004). This research has led to fairly conclusive results on the benefits of asynchronous CMC such as that they are preferable for promoting reflection and discussing complex ideas (e.g., Bonk, Hansen, Grabner-Hagen, Lazar, & Mirabelli, 1998; Davidson-Shivers, Muilenburg, & Tanner, 2001). Some educators experiment with using CMC to address the commonly mentioned problem of isolation among e-learners but asynchronous methods have not been sufficient in many cases, which has led to that some advocate the support of synchronous communication as a complement to asynchronous e-learning (Schullo et al., 2005). When and how to use synchronous e-learning is unclear, since research has been sparse and the results inconclusive. For example, Palloff and Pratt (1999) have argued that synchronous CMC “rarely provides for productive discussion or participation” (p. 47) while Leidner and Jarvenpaa (1995) found that such discussions resulted in increased and more equal communication when comparing with the traditional classroom.

There is increased pressure on teachers to incorporate IT, such as CMC, in order to support more active learning. Schullo et al. (2005) argue that there is a need to guide and support teachers and designers 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 different educational settings (Olaniran, 2006). Examples of such research efforts include Haythornthwaite's (2006) recommendations on how to facilitate collaboration and Olaniran's (2006) suggestions on 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 ones have, until recently, not existed.

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Asynchronous and synchronous communication is characterized by different discourse features and may thus be used for different pedagogical purposes (Romiszowski & Mason, 2004). In this paper, we propose design exemplars that illustrate when and how to manage and use synchronous e-learning as a complement to asynchronous e-learning. The exemplars have been developed through an iterative process comprising literature reviews (theoretical grounding) and a series of empirical studies (empirical grounding) conducted between 2003 and 2006. We have also tested the exemplars in focus group discussions with practitioners with experience of asynchronous and synchronous e-learning. The design exemplars are expected to contribute to practice but also to research since they can be tested and further developed in future research (cf. Markus, Majchrzak, & Gasser, 2002).

The paper is structured as follows: First, our view on how design research can develop relevant and applicable knowledge to support e-learning design is presented. In the next sections, we review previous research, describe design exemplars and give an overview of the series of studies on which they were initially grounded. Then, the design exemplars are empirically tested. Finally, limitations, suggestions for further research and conclusions are put forward.

2. Developing design theory for e-learning

Research should not only be rigorous but also need to address the utilization and relevance problem of current research (Hirschheim & Klein, 2003). In addressing this concern, mainstream behavioral research can favorably be complemented with design research (Hevner, March, Park, & Ram, 2004; Venable, 2006; Walls, Widemeyer, & El Sawy, 1992). Gregor and Jones (2007) argue that design research should not only concern prescriptions for designing technological products and applications but also for designing methodologies and interventions. The rationale of developing design theory for e-learning is that such theory can support practitioners to understand which mechanisms that may lead to desired outcomes.

Fig. 1 is adapted from Pawson and Tilley's (1997) model of realist casual explanation. The arrow labeled "Design exemplar" has been added to emphasize that the likelihood that outcomes of e-learning design can be improved if practitioners are given guidance based on what is currently known. However, the success is limited by contextual constraints (Pawson, 2006). Design exemplars should therefore aim to develop general and abstract knowledge rather than recipes. Thus, it is possible to take contextual variables into account, such as media use in groups of different sizes, but it is not possible to give guidance for every specific context. Instead, practitioners are suggested to design interventions, for example, the introduction of synchronous e-learning, based on experience, the specific context, and on the knowledge of the design exemplars (van Aken, 2006; Carlsson, 2007, 2010; Keys, 2007).

The process of the development of the design exemplars is illustrated in Fig. 2. The starting point was a practitioner problem. This paper is a response to practitioners needing guidance on when and how to use and design synchronous e-learning. Initial design exemplars could be proposed by continuously interacting with what is currently known, that is, grounding in kernel theories and previous research. Gregor (2006) distinguishes five interrelated types of theory (see Fig. 3). The figure reveals that all other types of theory can inform design theory: "Knowledge of people and information technology capabilities informs the design and development of new information systems artifacts" (p. 629). As illustrated in the figure, Gregor argues that design theory, and explanatory and predictive theory, are strongly interrelated. More specifically, van Aken (2005, 2006) maintains that design theory can be developed through cross-case analyses of previous case studies. This approach laid the foundation for our initial design exemplars. We also let kernel theories and findings from previous explanatory and predictive research guide our work. We drew upon social theory of learning (Vygotsky, 1978; Wenger, 1998) and the cognitive model of media choice (Robert & Dennis, 2005) as kernel theories and also conducted a systematic review of previous research. In sum, by drawing on a large and complex body of research, design researchers can support practitioners by developing comprehensible design exemplars that can support the improvement of outcomes.

Eventually, initial design exemplars were formulated. We aimed to provide "thick descriptions" to aid the reader in understanding the exemplars, which may support practitioners in translating them to specific contexts and situations (van Aken, 2005). Design exemplars do not guarantee success, but might support practitioners in developing a successful system or action. After having formulated initial design exemplars, the next step is empirical tests, which includes the selection of appropriate data collection methods (Carlsson, 2010). The empirical tests evaluate whether the design exemplars may be used as support when trying to "change" reality. Based on the results, the outcome may be reflected on and the exemplars may be refined. Through multiple studies one can accumulate supporting evidence iteratively and continuously move towards "evidence saturation." We can say that empirical tests of design exemplars go through alpha, beta, and gamma testing. Alpha testing concerns further development by the originator(s) of the design exemplar. Beta testing concerns further development by other researchers (van Aken, 2005). We suggest that it is also important to conduct gamma testing, which includes testing the design exemplars in practice, i.e. whether practitioners can use the exemplars and if their use may lead to desired outcome(s). Following a description of the initial design exemplars, the findings of focus groups are discussed, which were conducted to obtain feedback on the exemplars from experienced practitioners.

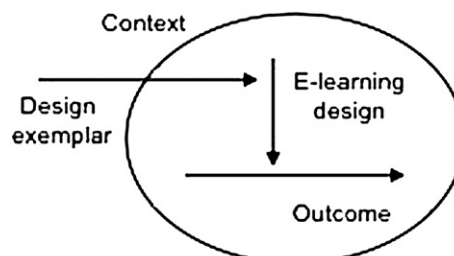


Fig. 1. Improving outcomes through design research (adapted from Pawson, 2006).

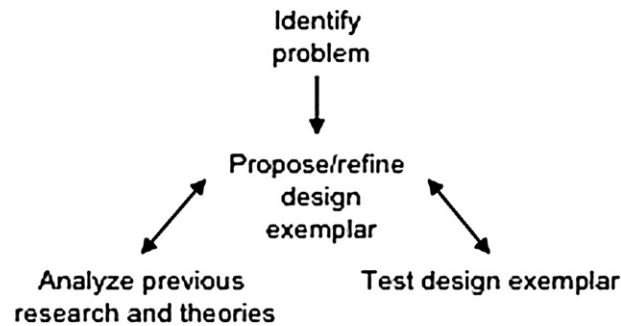


Fig. 2. Design exemplar development.

3. Previous research on synchronous e-learning

CMC is commonly classified as asynchronous or synchronous. However, it should be noted that it is the users, and not the medium per se, that decide how to use a medium. For example, in some studies, e-mail has been used near-synchronously since users may remain logged in and monitor their e-mail continuously (Haythornthwaite, 2000; Markus, 1994). Teachers do not only need to choose media suitable for various learning activities – they also need to stimulate beneficial use of the chosen media. Asynchronous and synchronous communication is characterized by different discourse features and may thus be used for different pedagogical purposes (Romiszowski & Mason, 2004).

Previous research has found that asynchronous communication is more suitable for reflection and discussion of complex ideas since more time may be spent on refining contributions (Bonk et al., 1998; Davidson-Shivers et al., 2001). Synchronous communication can be used as a complement because it is experienced as more social (Chou, 2002). It has been argued to enhance community (Dawson, 2006) and accelerate information flows within a team (Carr, Cox, Eden, & Hanslo, 2004). Moreover, since it has been acknowledged that feedback is less effective if it is delayed (Tuovinen, 2000) synchronous communication may be advantageous in some circumstances.

Leidner and Jarvenpaa (1995) showed that all members of a class contributed in computer-mediated synchronous discussions and that students communicated with each other or the entire class rather than on a one-to-one basis with the teacher, when comparing with the traditional classroom. It has also been concluded that synchronous live sessions help students to feel like participants rather than isolates: “Isolation can be overcome by more continued contact, particularly synchronously, and by becoming aware of themselves as members of a community rather than as isolated individuals communicating with the computer” (Haythornthwaite & Kazmer, 2002, p. 459). In fact, according to Kearsley (1995), distance education classes that communicate synchronously “often have a sense of excitement and spontaneity that is not present with delayed interaction”.

Several studies suggest that combining asynchronous and synchronous means of communication is preferable since different types of communication promote different types of participation (Haythornthwaite, 2000, 2001; Hrastinski, 2007a). The combination of means of communication support several ways for e-learners to get to know each other and collaborate on work (Haythornthwaite & Kazmer, 2002).

4. Our previous research on synchronous e-learning

Our previous research can be characterized as predictive and explanatory, and has been retrospectively analyzed to inform the development of the design exemplars (van Aken, 2005, 2006; Gregor, 2006). The purpose of the studies has been to examine when and how to use synchronous e-learning. Within-case analyses were performed, as well as cross-case analyses to discern patterns among cases. We followed the approach suggested by George and Bennett (2004) for doing case analysis with the purpose of developing what they call policy-relevant theory, that is, theory (knowledge) that can be used by practitioners (policy-makers) in decision making and action taking with the aim of “changing” reality. The discerned patterns laid the foundation for the design exemplars.

The process of data collection for the two phases of studies is summarized in Table 1. The first phase included a series of studies on an undergraduate online course in business English (BEO), which does not include any face-to-face meetings (Hrastinski, 2006a, b). The course

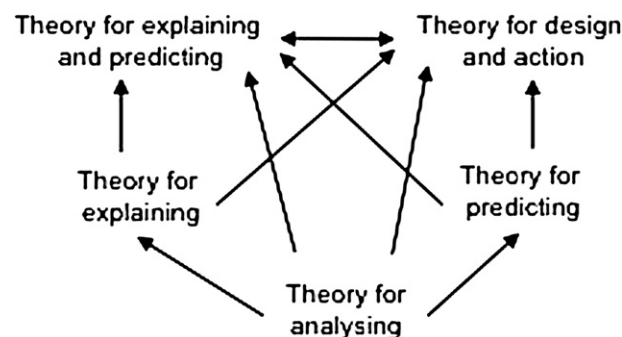


Fig. 3. Interrelationships among theory types.

Table 1
The process of data collection.

Study	Time period	Data collection	Purpose
1.1	Nov 04	Diary	Collect data on social networks during two weeks when learners 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.
1.1, 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.
1.2 & 1.3	Jan–Feb 05	Questionnaire	Collect data on perceived participation and social networks of the 2004 class.
1.3	Jun–Aug 04	Questionnaire	Collect data on perceived participation and social networks in the 2003 class.
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 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.

involves group discussions, and continuous assessment of individual and group work. Ever since the course was first offered in 2001, it has been delivered asynchronously and participants have communicated mainly via e-mail and discussion boards. However, there have been exceptions since some learners voluntarily chose to communicate synchronously (face-to-face, telephone, instant messaging) with fellow learners and the teacher. In 2004, which was the fourth offering of BEO, an instant messaging (IM) system was introduced and associated with an introductory activity that was mandatory. IM was introduced to support synchronous communication since waiting for answers from group members had caused a feeling of annoyance during the previous offerings. This may be a reason why many have preferred to work individually and have only engaged in a one-to-one relationship with the tutor (Lindh, Hrastinski, & Soames, 2005).

Learners that usually enroll can be described as computer literate adult learners, most of them working and some living abroad. Findings from studies on the 2003 and 2004 offerings are summarized in this paper. The BEO 03 learners consisted of three males and thirteen females. The BEO 04 learners consisted of five males and nine females. Their mean age was rather high: 31 years with ages ranging from 24 to 42 years. Thus, the findings may partly be generalizable to e-learning in organizations.

In sum, the findings revealed that when comparing learners 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 in the e-learning activities, were characterized by slightly denser social networks and spent more time working with content and communicating with peers (study 1.1, 1.2). Notably, the third comparison did not support these findings. Instead, the 2003 class, where IM was not used, was characterized by denser social networks and a higher level of perceived participation, as compared with the 2004 class (study 1.3). However, since different groups of learners were compared, other variables, such as learner attitudes towards online collaboration and synchronous media, might have affected participation.

In the second phase, two series of online discussions with master students on knowledge management were studied (Hrastinski, 2007b, 2008). The first case setting is a series of online discussions with learners from two courses on knowledge management offered during 2004. One of the courses was delivered by a university in Argentina and the other at a university in Sweden. Learners from the two universities participated in two asynchronous and two synchronous text-based online discussions over a two-week period. The online discussions followed introductory on-campus sessions. Although the Argentineans and Swedes never met, introductory sessions were arranged in Argentina and Sweden respectively. The second case setting is an online course on knowledge management offered during 2005. It is the first course in a Swedish part-time master program and it is equivalent to ten weeks of full-time studies. The learners of the course participated in two asynchronous and two synchronous text-based online discussions over four weeks. The online discussions followed introductory on-campus sessions. Learners that usually enroll can be described as computer literate adult learners, a majority of them working. The first class consisted of five males and three females and the second class consisted of five males and fourteen females. Their mean age was rather high: 41 years with ages ranging from 23 to 56 years.

In sum, the results indicated that using synchronous chat has the potential to affect participation in online discussions positively (study 2.1, 2.2). The learners contributed more and reported stronger perceived participation in the synchronous discussions, especially in the smaller class. In the synchronous discussions, learners did not feel restricted to only discussing course content, which may explain why these discussions were related with a higher level of participation. Notably, data collected on a completed course did not support these findings (study 2.3). Instead, these learners reported slightly stronger perceived participation in the asynchronous discussions, when being asked after the course was finished.

5. Design exemplars for synchronous e-learning

Below, the following four design exemplars on when and how to use and design synchronous e-learning are proposed and discussed:

- Design exemplar #1: Use synchronous e-learning to support strong group-wide relations
- Design exemplar #2: Use synchronous e-learning to support weak class-wide relations
- Design exemplar #3: Use synchronous e-learning for task support
- Design exemplar #4: Use synchronous e-learning for social support

As overarching kernel theories, we used sociocultural learning theory (Säljö, 1999; Vygotsky, 1978) and Wenger's (1998) theory of learning as social participation. These two perspectives agree upon the social nature of learning. In the sociocultural tradition, the term culture is used to describe knowledge and other resources that exist within the individual, in social interaction and in tools (Säljö, 1999). Wenger (1998) emphasizes participation, which he refers to as "a process of taking part and also to the relations with others that reflect this process" (p. 55). These and other social theories on learning emphasize that learning is dialogue, both internal and by social negotiation (Jonassen & Land, 2000). Rather than being solely based on experience with the physical world, the construction of knowledge and understanding is seen as a fundamentally social activity (Littleton & Häkkinen, 1999, p. 24).

5.1. Design exemplar #1: use synchronous e-learning to support strong group-wide relations

5.1.1. Our research

Study 1.1 revealed that two of the four project groups chose to communicate synchronously by IM. Project groups that were characterized as adopters were related with a higher level of participation compared to non-adopters. The adopters used IM as a complement to, rather than, replacement of e-mail. The sociogram of communication by IM (see Fig. 5) illustrates that the learners mainly used the medium to communicate with their group members. The letter of each node denotes which project group each learner belonged to – there were four groups (A–D). In most cases the discussions that occurred were unscheduled. Usually, learners would not have an agenda, but instead spontaneously began communicating. IM was used to enable learner-organized meetings, and optional opportunities for communication. The figure illustrates that the learners mainly used IM to communicate with their group members. This differs from the synchronous discussions of the second phase, where learners maintained weak ties with many peers. In sum, this seems to be an example of group-wide communication.

A comparison of study 2.1 (smaller class) and study 2.2 (larger class) of the second phase indicates that using synchronous media may especially enhance participation in smaller groups (see Table 2). The difference in means achieved statistical significance 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). Moreover, Fig. 4 illustrates that learners' social networks were denser when communicating synchronously in the smaller class, while the difference in network density was small in the larger class. These findings are also supported by the number of written sentences, which shows that the learners of the smaller class wrote four times as many sentences in the synchronous discussions while the difference was smaller in the larger class (see Table 3).

5.1.2. SKernel theory and previous research

The cognitive model of media choice postulates that receivers are more committed to read and respond to messages when communicating synchronously (Robert & Dennis, 2005). It suggests that learners respond quickly in synchronous conversations 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 the learners feeling part of a more intense and motivating experience. However, the model explains that a high number of learners 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 learners in synchronous discussions, can lead to confusion since many learners may respond to many messages simultaneously. It then becomes unmanageable to know who is answering what to whom (Contreras-Castillo, Perez-Fragoso, & Favela, 2006) and, logically, this issue is of more concern in larger groups. Palloff and Pratt (1999) argue that the "critical mass" needed to get discussions going in synchronous settings is low and that an ideal size for synchronous classes are less than ten learners.

5.2. Design exemplar #2: use synchronous e-learning to support weak class-wide relations

5.2.1. Our research

All learners of study 2.2 were asked to submit a questionnaire following two synchronous discussions. In each questionnaire, the learners were asked to report which others they had communicated with during the discussion. The discussions were mandatory, i.e. learners were expected to participate in order to pass the course. The sociogram of the synchronous discussion (see Fig. 5) reveals that formal applications, such as using synchronous communication to bring the class together for lectures or discussions, enable weak ties to develop among learners. The learners felt they communicated with many other learners and not only with the teacher or those they knew, such as project group members.

5.2.2. Kernel theory and previous research

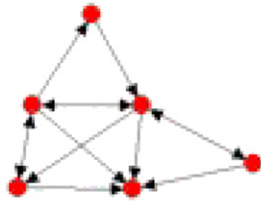
This design exemplar primarily enables infrequent contact among learners, but the benefits should not be underestimated (Haythornthwaite, 2006). Social network studies have revealed the strength of weak ties: Persons that are weakly tied are less likely to share information, although, when they do, the types of resources and ideas are more diverse (Granovetter, 1973). However, as predicted by the cognitive model of media choice, such information exchanges seem to be characterized by decreased cognitive effort, when compared to asynchronous information exchanges (Robert & Dennis, 2005).

Table 2

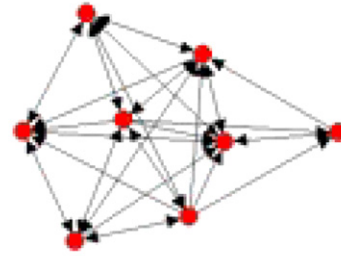
Perceived participation in synchronous (S) and asynchronous (A) discussions on a five-point ordinal scale for study 2.1, 2.2 and 2.3.

	Study 2.1				Study 2.2				Study 2.3			
	S (n = 13)		A (n = 11)		S (n = 31)		A (n = 32)		S (n = 17)		A (n = 17)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	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	3.5	1.0	3.7	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	3.2	1.2	3.1	0.8
3. As a learner, I felt part of the discussion.	4.4	0.5	3.9	0.8	4.2	0.7	4.0	0.8	3.7	1.0	4.1	0.9
4. I felt comfortable interacting with participant(s).	4.3	0.6	3.7	1.3	3.8	1.0	4.0	0.4	3.5	1.4	4.0	1.0
5. As a learner, I felt personally involved in the discussion.	4.4	0.5	4.3	0.5	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.	4.3	0.5	3.9	1.1	4.0	0.7	3.9	0.7	3.4	1.0	3.5	1.0
7. I felt that learners in the discussion cared about each others' opinions.	4.2	0.4	3.8	1.0	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.	4.2	0.6	3.4	1.1	4.0	0.8	3.9	0.6	3.4	1.2	3.6	1.0
Total	4.2	0.7	3.7	1.2	4.0	0.9	3.9	0.8	3.4	1.1	3.7	1.0

Study 2.1

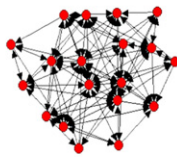


Asynchronous discussion, network density = .43

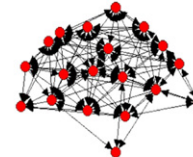


Synchronous discussion, network density = .68

Study 2.2



Asynchronous discussion, network density = .42



Synchronous discussion, network density = .46

Fig. 4. Sociograms illustrating whom learners perceived they had communicated with when using the asynchronous medium (left) and synchronous medium (right). The sociograms were created with Ucinet 6 (Borgatti, Everett, & Freeman, 2002).

5.3. Design exemplar #3: use synchronous e-learning for task support

5.3.1. Our research

The studies of both phases have showed that learners spent more time exchanging task support when using a synchronous medium. The learners that chose to use a synchronous medium (IM) to support group work primarily used it to maintain 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 indicated that the synchronous discussions were characterized by higher relative degrees of task support exchanges, compared to asynchronous discussions (see Table 3). In synchronous discussions, learners 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 learner. However, the corresponding frequency of task support exchanges when using an asynchronous medium was between 0 and 2 sentences per learner.

5.3.2. Kernel theory and previous research

Task support relations are essential, especially when learners produce some kind of product, such as an assignment, in collaboration with peers. Therefore, it is important that e-learners gain support to accomplish such exchanges (Haythornthwaite & Kazmer, 2002). Malmberg (2006) presents evidence that supports this design exemplar. He found that self-organizing groups of learners who had access to both discussion board and chat chose the latter to support task support relations.

5.4. Design exemplar #4: use synchronous e-learning for social support

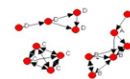
5.4.1. Our research

The studies of the first phase found that learners rarely felt that they exchanged social support. The only exception was among some of the learners that chose to use 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 (see Table 3). Such exchanges accounted for between 13 and 15 sentences per learner, while the asynchronous discussions included 0 to 3 such sentences per learner. One explanation is that social interaction usually occurred in the beginning and end of each discussion. Study 2.3 revealed that learners especially appreciated immediate feedback and social presence in the synchronous discussions. It should, however, be noted that both the second item of the measure on



Example 1: Chat discussion, network density = .46



Example 2: IM, network density = .17

Fig. 5. Social networks of learners when using chat (left, study 2.2) and IM (right, study 1.2).

Table 3
Mean number of sentences per learner and standard deviations for study 2.1 and 2.2.

	Study 2.1 (n = 24)				Study 2.2 (n = 72)			
	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
Total	86	30	20	15	84	26	62	36

perceived participation and sentence counts per learner (see Tables 2 and 3) were related with high standard deviations, which tells us that some learners exchanged social support frequently, while others chose not to engage in such exchanges. There are probably many factors that affect why some learners 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 learners 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 eighth items (see Table 2).

5.4.2. Kernel theory and previous research

Social support relations are desirable when maintaining relationships to foster knowledge work and collaborative learning (Cho, Trier, & Kim, 2005; Kreijns, Kirschner, & Jochems, 2003). Such relations are important to create an atmosphere where participation is encouraged. Anecdotes and personal experiences encourage trust, which in turn foster receptive and creative learning environments (Hillman, 1999). The classes of the second phase followed a tight schedule, which may be one reason for a lower level of social support compared to previous studies. For example, Chou (2002) classified 33% of the sentences examined as socio-emotional in an upper-level undergraduate course and Orvis, Wisher, Bonk, and Olson (2002) classified 30% of chat lines as social in online military training.

6. Empirical test and evaluation of the initial design theory

One of the steps of design theory development is the empirical test (see Fig. 2). Empirical and theoretical evidences have been used to ground and motivate the design exemplars. In this section an empirical gamma test, i.e. a test with practitioner involvement, of the exemplars is described. First, the method of the test is presented and then the results are presented and discussed.

6.1. Test and evaluation method: focus groups

Krueger (1994) argues that focus groups is an appropriate method for evaluating the effects of interventions in social contexts; and Kazi (2003) shows how focus groups can be used in evaluation research. Drawing on this interest and the experiences from using focus groups in evaluation research it seems that focus groups can be appropriate for evaluating design exemplars by obtaining feedback from experienced practitioners (cf. Tremblay, Hevner, & Berndt, 2008). According to Morgan (1997), the hallmark of focus groups is their explicit use of group interaction to produce data and insights that would be less accessible without the interaction found in a group. Focus groups are flexible enough to handle a wide range of topics and allows for the researcher to clarify questions as well as exploring respondents' positions on key issues (Stewart, Shamdasani, & Rook, 2007).

Over the years, some "rules of thumb" have developed for focus group research design. These include recommendations for the size and number of focus groups and characteristics of participants. We decided to conduct focus groups with three to five participants in each group since small groups have been found useful when the participants are likely to be interested in the topic and the researchers wish to obtain a detailed understanding of each participant's opinions (Morgan, 1997). We conducted three focus group sessions. Two of the focus groups were homogenous. The first group, hereafter referred to as *the teachers*, included teachers and the second group, hereafter referred to as *the experts*, included managers, administrators and developers. A homogenous group "allows for more free-flowing conversations among participants within groups but also facilitates analyses that examine differences in perspectives between groups" (Morgan, 1997, p. 35). The third focus group, hereafter referred to as *the mixed group*, included both teachers and experts. Smaller groups of heterogeneous individuals have been argued to be more likely to produce unique or creative ideas (Fern, 2001). Thus, by conducting both homogenous and heterogeneous focus groups, we aimed to combine the strengths of both approaches. Descriptive data for the focus groups is displayed in Table 4.

The three focus group interviews lasted for an hour each and were performed in the videoconference system Marratech. The participants had experience of asynchronous and synchronous media in online courses on different subjects and levels. Most of them had many years of experience of these media. A funnel structure was used (Merton, 1990), which allowed the participants to describe their own personal experiences of synchronous media. This was followed by a discussion where the focus groups, for each design exemplar, were asked whether they understood the exemplar and agreed with the exemplar and could provide examples of when the exemplar may or may not be applicable and actionable. One of the authors acted as moderator, while a second author mainly observed the discussions and noted key issues. The focus group sessions were recorded and transcribed. Subsequently a transcript-based analysis (Krueger, 1994) was made to

Table 4
Descriptive data of the participants in the focus groups.

Focus group	Males	Females	Ages
The teachers	2	1	48, 55, 63
The experts	4	1	47, 48, 49, 55, 57
The mixed group	4	1	32, 44, 48, 58, 59

summarize the responses from each focus group by each design exemplar. Emerging themes of the discussions were then identified and categorized.

7. Results and discussion

In this section, the results are presented and discussed for each design exemplar. Then, the findings are summarized and suggestions for further development of the design theory, which were put forward by the participants of the focus groups, are discussed.

7.1. Design exemplar #1: use synchronous e-learning to support strong group-wide relations

Drawing on the focus group discussions, there is strong support for the first design exemplar, i.e. that synchronous communication especially is useful in smaller groups. The groups agreed that there is a “critical mass” of participants for synchronous communication, and several participants argued that it is difficult to conduct a discussion with more than ten participants. The male experts of the mixed focus group pinpointed the risk of certain participants dominating the discussion in large groups.

In the focus groups, several critical conditions for using synchronous media to enhance participation were identified. The focus groups argued that the need for preparation and structure in synchronous discussions increase with the number of participants. One of the male experts argued that it is possible to conduct discussions in larger groups, but then the class needs to be divided into smaller groups and the discussions need to follow a clear structure prepared in advance. Thus, it becomes more and more complicated to use synchronous media to enhance participation as the group size increases. One explanation identified is that learners sometimes involve themselves in monologues rather than dialogues, because of an urge to present their point of view. This is, however, achieved, at the expense of listening or engaging in dialogue with other learners and teachers. The need for organization seemed especially evident when using text-based media in large groups, where several conversations may occur simultaneously, to decrease what the experts labeled *chat confusion*. The experts also maintained that the lecture model of teaching, where the teachers mainly lecture and the learners mainly listen, is not likely to enhance participation. Instead, they emphasized the importance of addressing the individual needs of each learner, if participation is to be enhanced.

One expert in the mixed group maintained that this guideline was in line with his and his colleagues' approach towards teaching and learning: “It corresponds with our social constructivist model of learning, where we want learners to meet in smaller groups to exchange experiences”. Moreover, one of the male teachers had experience of encouraging the learners to use synchronous chat when working with group projects, which had been fairly successful. The experts had limited experience of supporting learners in building strong relations. However, they agreed that arenas for supporting social exchanges, which in turn, can lead to strong relations, are necessary. This is explained by one of the male experts: “When you log on to a learning environment, you should be able to meet someone, to extend your network”.

7.2. Design exemplar #2: use synchronous e-learning to support weak class-wide relations

In the focus groups, it was argued that videoconferencing could be a good means for learners and teachers to get to know each other. This makes synchronous communication especially useful in the beginning of a course. In fact, one teacher argued that denser class-wide social networks develop in online synchronous sessions, since all the participants can read, hear or observe the social exchanges that occur. “I very much believe in synchronous communication to knit a group together.” (Male teacher). However, it may be difficult to schedule sessions, where most e-learners can attend and often few learners attend voluntarily. When this is the case, the experts recommended scheduling weekly meetings for those who can attend.

7.3. Design exemplar #3: use synchronous e-learning for task support

We mainly identified support for the third design exemplar in the expert group and the mixed group. However, one of the male teachers had experience of supporting learners to use synchronous chat when working with group projects, which had been somewhat successful. It seemed difficult for the teachers to assess the relative degree of task support exchanges, compared to the frequency of discussing course content, in their classes.

Synchronous media were argued to be more useful to support task support exchanges such as planning work. It was also mentioned that negotiation, followed by decisions, could be accomplished more easily when using synchronous media: “Imagine four learners negotiating. They observe each other. It is like bargaining. To negotiate over several days [asynchronously] is ... non-dynamic. This is one of the reasons why planning and decision making is easier [by synchronous media]. ... I believe that, when agreeing about who does what and when, in a chat or by other synchronous media... people are more likely to keep their promises.” (Male expert). This argument is in line with the cognitive model of media choice. As discussed earlier, it 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). It seems likely that, after negotiating and coming to an agreement on who does what and when to deliver, learners may be more motivated to complete their tasks. One male teacher and one male expert of the mixed focus group mentioned the usefulness of supporting task support exchanges by synchronous media, such as setting dates for seminars or dividing learners into groups: “To find appropriate times and places is nearly impossible if you try to do it asynchronously” (Male teacher).

7.4. Design exemplar #4: use synchronous e-learning for social support

There was general agreement among the teachers and experts on the accuracy of the fourth design exemplar. It was argued that synchronous communication enables learners to get to know each other in different ways than by asynchronous communication: “I think that meeting in real-time is a social situation, even if sticking to the course content. There is also a lot of small talk before everyone has entered the conference.... It is a way of stimulating the social, to create relations.” (Male teacher). The focus groups agreed that synchronous communication better supports social exchanges and regarded such exchanges as an essential ingredient of e-learning: “Small talk and

Table 5
The degree of empirical support for each design exemplar.

Design exemplar	The teachers	The experts	The mixed group
#1 Use synchronous e-learning to support strong group-wide relations	<i>Strong</i> “Yes, the guideline is correct! If you are too many there is not enough time to talk with everyone. It becomes difficult to follow the discussion and sometimes even difficult to see who is present.” (Male)	<i>Strong</i> “I have worked with online courses and the synchronous meetings have had strong social importance.” (Female)	<i>Strong</i> “[Synchronous communication] is suitable for smaller classes or groups. We want learners to meet in smaller groups to exchanges experiences.” (Male expert)
#2 Use synchronous e-learning to support weak class-wide relations	<i>Strong</i> “The learners get to know each other much better, and the learners get to know the teacher, if you introduce synchronous communication.” (Male)	<i>Strong</i> “I very much believe in synchronous communication to knit together a group.” (Male)	<i>Intermediate</i> “I think that [synchronous communication] works in larger groups if you understand the technology and have some kind of rules for communicating.” (Male expert)
#3 Use synchronous e-learning for task support	<i>Intermediate</i> “The learners... can work with collaborative tasks by using the chat, which they sometimes do.” (Male)	<i>Strong</i> “Planning and decision making is easier [by synchronous media]” (Male)	<i>Strong</i> “To find appropriate times and places is nearly impossible if you try to do it asynchronously. ... But [synchronous communication] works!” (Male teacher).
#4 Use synchronous e-learning for social support	<i>Strong</i> “Meeting in real-time is a social situation.” (Male)	<i>Strong</i> “The synchronous meeting has a strong social meaning.” (Female)	<i>Intermediate</i> “I have an e-café [in my course] where you can go and just meet people. ... But I don't know, the learner groups have been small and they haven't really jumped at it.” (Male expert)

gossip is an immensely important part of building a sense of social community. As far as I know, small talk is non-existent, or does not occur as spontaneously, by asynchronous media.” (Male expert). However, the focus groups of the teachers questioned that a significant extent of class time was devoted to social exchanges: “I hardly use any time for anything else. It is much focused.” (Male teacher). Nevertheless, this teacher acknowledged, “that times of other communication than what's on the agenda occurs.” In the mixed focus group, the support of the accuracy of this design exemplar was somewhat weaker. The participants acknowledged the importance of social support exchanges, but were not sure how to support such exchanges: “I have an e-café [in my course] where you can go and just meet people. ... But I don't know, the learner groups have been small and they haven't really jumped at it.” (Male expert).

8. Conclusions

The purpose of this paper has been to develop design exemplars for when and how to use and design synchronous e-learning. In Table 5, the degree of support for each design exemplar is summarized. There were few examples of remarks that contradicted the exemplars. We identified strong support for the first exemplar and rather strong support for the remaining exemplars. Both the teacher and expert groups argued that researchers should be cautious and not try to create too general theories of synchronous e-learning, since the characteristics of text-based, audio-based and video-based communication are very different. They argued that a plethora of media need to be available, which makes it possible for learners and teachers to choose the media they prefer in different situations. However, teachers and learners need guidance in choosing media that are appropriate in specific situations: “We introduce online tools but then there is a problem: ... It takes many years of training and reflection to learn how to use [the tools] in a good way.” (Male expert). In short, further developments of this design theory need to better take account of “which medium that is suitable for different activities” (Female expert).

We do not believe that it can be justified logically to propose *the* design theory of synchronous communication, which can suggest how synchronous media should be appropriately used in every context. Instead, as previously discussed, the output of design research should be to develop abstract knowledge rather than recipes. Practitioners are suggested to design interventions based on experience, the specific situation and context, and on the knowledge expressed in the design exemplars (van Aken, 2004; Carlsson, 2006, 2007; Keys, 2007).

This design study is an important step towards developing design exemplars that practitioners find understandable and actionable. Further research that test, criticize and further develop the exemplars, by studying both similar and different contexts, is needed. The design exemplars in this paper has focused on *when* and *how* to use and design synchronous e-learning. The participants of the focus groups called for further developing the exemplars so that it better takes account of different types of synchronous media, depending on whether media support text, audio and/or video. In line with this call, we also anticipate that a future research challenge will be to put more effort into developing design exemplars for *how* synchronous e-learning should be appropriately used: “People have realized that the technology is good enough now. ... How should the technology be used?... [Participants of online courses need support] to make sure that they use [technology] when it's actually useful. I think we need more guidelines to learn by what others are doing.” (Male expert). For example, the first design exemplar maintains that synchronous media may be used to enhance participation in smaller groups. By drawing on this exemplar, the next step would be to investigate how different types of synchronous media may be beneficially used in different circumstances.

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