Allocated online reciprocal peer support via instant messaging as a candidate for decreasing the tutoring load of teachers

Gijs de Bakker

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Dankwoord

In mijn ambitie mijn carrière in het wetenschappelijke veld voort te zetten… Dat was tevergeefs het begin van mijn eerste sollicitatiebrieven gericht aan hoogleraren.

Ik was in mijn loopbaan tot dan toe communicatie-adviseur geweest, en dat leek synoniem voor "ik ben niet klaar voor de wetenschap". Toen was daar Fontys, dat nieuwe ideeën had over de toekomst van het HBO. Onderdeel daarvan was 't promotietraject voor mensen met de ambitie mee te bouwen aan die toekomst.

Begin 2006 kon ik Peter - toen nog lector - overtuigen, en zo hoorde ik bij de eerste lichting van HBO-promovendi die de Universitaire wereld zo in beroering brachten. Om de kwaliteit te waarborgen werden ervaren hoogleraren aangetrokken om de onderzoeksprojecten te begeleiden. In mijn geval was dat Wim Jochems, die de Eindhoven School of Education ging leiden, een instituut van Fontys en de TU/e. "Yes!" Nu kon ik daadwerkelijk mijn carrière in de wetenschap voortzetten.

Raar was het dan ook om gaandeweg te beseffen dat de wetenschap mij toch niet op het lijf geschreven leek. Het soms wat eenzame werk, de politieke krachten, het concentreren op de kleinste details, het bleek me niet te blijven boeien. Opgeven komt niet in mijn woordenboek voor en dus zocht ik motivatie in activiteiten en mensen om een goede afronding toch mogelijk te maken. Experimenten opzetten, toetsen van hypothesen, nieuwe tools ontwikkelen, en vooral schrijven.

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dr. Gijs de Bakker

CHAPTER 1

Introduction

1.1 Background to the study

As Sloep and Jochems (2007) among many others point out, the digital revolution, which started in the 1980s when the personal computer was introduced to our homes, has had enormous impact on our work and social life, but also on education (Westera & Sloep, 2001). Thus, the introduction of computers and the internet has lead to an increased flexibilisation in higher education, evidenced by for instance an increase in learning independent of place and time. As a result, student populations are more heterogeneous. For example, students are engaged in their study activities at different moments. Besides, higher education is moving towards self-regulated learning, leading to an increase in individual support to be provided by the teacher. As a result, teachers are faced with a growing number of student questions, which has increased their workload (Fox & MacKeogh, 2003; Rumble, 2001). More specifically, where teachers previously could answer similar students' questions all at once during a lecture, they are now faced with the same questions being asked several times via e-mail. The impact of this growth is even reinforced by younger students expecting other people to use modern communication tools as they do themselves (Prensky, 2001; Simons, 2006); students use ICT regularly and expect their teachers to do the same. And indeed, teachers indicate that specifically the answering of student questions is specifically time-consuming (De Vries et al., 2005). Attempts have been made to provide a solution to this problem by introducing online reciprocal peer support systems (e.g. Van Rosmalen et al., 2006; Sloep et al., 2007). In these cases, questions students have while studying are answered by fellow-students acting as peer tutors, for which computer applications (De Bakker, Sloep & Jochems, 2008) or web services (Van Rosmalen et al., 2008) have been used. 'Reciprocal' here means that students can be both tutee and tutor to each of their fellow-students. Characteristically, the allocation of peers in such systems is not self-regulated, as is for instance the case when using bulletin boards; instead it is mediated by the system itself. Mediation in this case refers to the direct allocation of peers based on their competence to answer specific questions. This has some important benefits, as pointed out by Westera (2007): a) someone becomes explicitly responsible to offer the support, b) the likelihood of support becoming available is increased, c) allocation results in the selection of the most competent peer tutor, d) the time before getting an answer can be reduced, and e) peer tutor load can be distributed more evenly over the population. Therefore, online reciprocal peer support seems an interesting approach in higher education to help to reduce teaching load. There is one provision of course, which is that support thus provided is of sufficient quality.

1.2 Focus of the dissertation

Similar previous initiatives for online peer support systems have some important drawbacks. They are either suitable for larger populations (Westera, 2007), or the support is given asynchronously, confronting tutees with a waiting time (Van Rosmalen et al., 2006). To develop an online reciprocal peer support system that is suitable for smaller population sizes and that provides students with support more quickly, in this dissertation the SAPS system (Synchronous Allocated Peer Support) was introduced. Via the SAPS system, students with questions during their learning are allocated to competent fellow-students for answering. SAPS is designed for reciprocal peer support activities among a group of students who are working on the same fixed and stand-alone modular material every student has to finish, such as courses with separate chapters. The system connects students with questions on the learning material to peers who should be able to answer these questions, based on their competence. 'Competence' is operationalised here as 1) proximity: prioritising peers who are working on the same learning unit (e.g. course module, task) or who have recently completed it, 2) question type: prioritising peers who have indicated to be competent at answering certain question types, and 3) previous result: prioritising peers who have performed well in the past. The communication between peers takes place via instant messaging (IM). The SAPS system is lightweight in the sense that it needs little student data and data on the learning material at hand. It offers quick support on the one hand, while offering students support of sufficient quality on the other hand. This study focuses on whether online reciprocal peer support could serve as a proper alternative for teacher support when that is not available. Any system that offers this kind of support should meet certain requirements in order to be able to be implemented successfully, therefore in this dissertation we analyse the following requirements:

1) Students' should have positive attitude towards online reciprocal peer support.
2) Students selected to act as peer tutor should have sufficient peer competence and a system for online reciprocal peer support should be sustainable (i.e. students need to remain willing to help their peers).
3) The support provided via online reciprocal peer support should be of sufficient quality.

1.3 Structure of the dissertation

In Chapter 2 the theoretical framework of the research project is presented, discussing the problem definition, a review of research on the proposed solution of (online reciprocal) peer support as well as an introduction to the requirements analysis. The latter is used as the framework for the structure of the remainder of the dissertation. Regarding the first requirement it is important that students have a positive attitude towards online reciprocal peer support and the way in which it is organised (e.g. online and via instant messaging). The main concern is that it actually fits their support demands. The first requirement will be studied in Chapters 3 and 4. Chapter 3 explores whether Instant Messaging, a communication tool that offers peer-to-peer chat communication between two computers, would be a suitable candidate as online peer support medium. To that end a survey was conducted to gain insights in students' current IM use and demands for a possible educational implementation. Chapter 4 is devoted to a first pilot study in which two groups of students worked with an online peer support system supplemented with instant messaging as the primary communication medium, in order to measure their general attitude towards online reciprocal peer support via instant messaging. The second requirement is that peers are sufficiently competent to help fellow-students, and that the system is sustainable over time (i.e. that students remain willing to act as peer tutor over a longer time period). This requirement will be dealt with in Chapter 5, as that will be devoted to the description of the SAPS allocation algorithm and a simulation study on peer competence and sustainability of the algorithm. If the second requirement of peer competence is met, it does not automatically mean that the support itself is of sufficient quality as well, since peer competence does not provide information on how peer tutors will actually answer questions. Therefore, Chapters 6 and 7 will be devoted to experimental studies on answer quality and test performance of students using a SAPS-based online peer support system, in order to answer to the third requirement: that the eventual support given by peers is of sufficient quality. At the same time, Chapter 7 is focused on finding empirical proof for the assumptions underlying the simulation study of Chapter 5. In Chapter 8 the most important findings of the research are discussed, as well as the general conclusions, methodological considerations, practical implications of the project, and opportunities for future research. Table 1.1 presents a brief overview of the different chapters in this dissertation with their contents.

Table 1.1: *Overview of the dissertation*

Chapter	Contents
2: Synchronous allocated online peer support as a candidate for decreasing the tutoring load of teachers.	Theoretical framework of the research project. Presentation of requirements to be met for a system for online reciprocal peer support to succeed.
3: Exploring Instant Messaging as an online peer support communication medium: survey on students' current educational use and demands.	**Requirement 1:** Students' positive attitude towards online reciprocal peer support. As part of the first requirement a student survey was conducted to explore whether IM would be a suitable online peer support medium.
4: Towards a system for allocated peer support via instant messaging: a pilot study.	**Requirement 1:** Students' positive attitude towards online reciprocal peer support. As part of the first requirement a pilot study was conducted to measure students' general attitude towards online reciprocal peer support via instant messaging.
5: Introducing the SAPS system and a corresponding allocation mechanism for synchronous online reciprocal peer support activities.	**Requirement 2:** Sufficient peer competence and sustainability. The competence of peers selected via the system as well as its sustainability over a longer usage period was tested in a simulation study.
6: The influence of synchronous online reciprocal peer support on answer quality, test performance and student satisfaction with peer support.	**Requirement 3:** Sufficient support quality. As part of the third requirement an empirical study was conducted to measure the peers' answer quality as well as learning performance of peer-supported students and students' attitude towards online reciprocal peer support.
7: The quality of synchronous online reciprocal peer support in the context of distance education without teacher availability.	**Requirements 2 & 3:** As part of the second and third requirement an empirical study was conducted to measure the peers' answer quality, willingness to help fellow-students and students' attitude towards online peer support.
8: Conclusions and discussion.	Main conclusions of the research project and discussion of the various findings.

CHAPTER 2

Allocated online reciprocal peer support via instant messaging as a candidate for decreasing the tutoring load of teachers

Abstract

Our daily lives have changed as a result of the digital revolution that started in the 1980s (Sloep & Jochems, 2007). This has also had consequences for the ways in which we educate our students (Westera & Sloep, 2001). For example, learning independent of place and time plays an increasing role in today's education. As a result, today's students are more and more involved in different activities at different moments, making student populations much less homogeneous as far as their tutoring needs are concerned (Anderson, 2004). Plausibly, this leads to an increasing workload for teachers (Fox & MacKeogh, 2003), since they have to cater for various tutoring needs at any time (De Vries et al., 2005). Indeed, according to Rumble (2001), the tutor load has even doubled in today's education. At the same time, students' tutoring expectations have changed. A young generation of students that grew up with ICT being embedded in their daily lives (Prensky, 2001), have become used to the nearly instant availability of information and support through the internet. These expectations penetrate education more and more. For example the ease with which guidance can be sought via ICT, has lowered the barrier to do so (Simons, 2006). This chapter explores the concept of online reciprocal peer support as a means to decrease teachers' high tutoring load. Based on requirements that we believe a system for peer support needs to meet in order to succeed, various models for organising peer support are explored before arriving at a starting point for a new system for online reciprocal peer support.

2.1 Introduction

Education has always been the subject of much research and debate particularly when it comes to innovations required to meet up to an ever-changing society. In this chapter, we try to identify some recent changes in society and trends in education. We will then propose a solution for some problems that have arisen from these educational trends. As Sloep and Jochems (2007) point out, the digital revolution, which started in the 1980s when the personal computer was introduced, has had enormous impact on our work and social life. Our industrial economy has changed under the influence of technological innovations, which have made information and communication easily available to every member in society. Currently, we therefore speak of a knowledge (WRR, 2002) or networking society (Castells, 1996). This, in its turn, has had many consequences for the ways in which we educate our students (Westera & Sloep, 2001). For example, since knowledge has become more volatile, life-long learning has become increasingly important. At the same time higher education itself has been subjected to change. In part this has been an autonomous development, in part it constitutes a reaction to the societal changes indicated. Many educational institutes have transformed their approach to one that is more self-regulated in which students are expected to take the initiative in their process of acquiring knowledge, skills and attitudes. This student-centred model stands in marked contrast with the more traditional model, which relies on set curricula and features teacher-to-student knowledge transfer (Klarus, 2000; Mazzolini & Maddison, 2003). Furthermore, students are increasingly involved in group work since learning or working in groups is found to be beneficial (Cartney & Rouse, 2006; Chapman, Ramondt & Smiley, 2005; Johnson & Johnson, 1989; Keppell, Ma & Chan, 2006), and they are working on more authentic tasks to emulate the environment they are educated for.

While teaching strategies other than traditional classroom education are becoming widespread (Westera & Sloep, 2001), learning independent of place and time plays an increasing role in today's education, which was partly caused by the digital revolution making learning available for students at any time and location. Today students are ever more involved in different activities at different moments, making student populations less homogeneous as far as their tutoring needs are concerned (Anderson, 2004). Plausibly, this leads to a growing workload for teachers (Fox & MacKeogh, 2003), since they have to cater for various tutoring needs at any time (De Vries et al., 2005). Indeed, according to Rumble (2001), the tutor load has even doubled in today's education. For example, where teachers previously could answer similar students' questions all at once during for example a lecture, they are now faced with the same questions that are being asked several times via e-mail. This development is reinforced by students' changing tutoring expectations. A young generation of students that grew up with ICT being embedded in their daily lives (Prensky, 2001), have become used to the nearly instant availability of information through the internet, and the almost immediate accessibility of everyone through instant messaging (De Bakker, Sloep & Jochems, 2007) or phone-based text messaging (SMS). These expectations penetrate education more and more. For example, the ease with which guidance can be sought via ICT has lowered the barrier to do so (Simons, 2006).

2.2 Towards a solution: peer support

2.2.1 Using the concept of peer tutoring to decrease teachers' tutor load

Tutoring is still mainly in the hands of teachers. Over the last decades, educational research has explored whether students could take over (parts of) teachers' tutoring tasks by acting as peer tutors. Peer tutoring is a form of tutoring in which students guide each other through collaborative learning (Griffin & Griffin, 1998). Goodlad & Hirst (1989) and Topping (1996) define peer tutoring as an instructional system for learners to help each other and learn themselves by teaching. The possible advantages of educational peer tutoring have been subjected to research. It has a positive effect on the learning process and knowledge construction (Fantuzzo, Dimeff & Fox, 1989; Gyanani & Pahuja, 1995; King, Staffieri & Adelgais, 1998; Wong et al., 2003). For example, Fantuzzo et al. (1989) created a setting in which learners had to create a set of multiple-choice questions, with guidance as to where the answers could be found in the learning content. After a group of tutees was subjected to the questions, the tutor scored the answers and discussed the mistakes with the tutees. Fantuzzo et al. (1989) found higher learning outcomes and more social interaction in a peer tutoring setting, as compared to several control groups such as a group that received video-based instruction. This, they argue, was caused by the element of structured exchange between students subjected to the peer tutoring. King et al. (1998) argue that a structured approach to learning enhances the dialogue between tutor and tutee to a higher cognitive level, (e.g. mutual exchange of ideas, explanations, justifications, and conclusions), from which in turn tutors also benefit (Fantuzzo, et al., 1989). The last phenomenon was also found by other researchers and is known as the self-explanation effect (Ainsworth & Loizou, 2003; Chi et al., 1994) It is therefore valuable if students take on both the tutor and tutee role (Fantuzzo, et al., 1989, King, et al., 1998; Wong, et al., 2003). Other studies found that peer tutoring stimulates interactions leading to knowledge construction (Gyanani & Pahuja, 1995; Slavin, 1995). Other findings are that students can become more motivated by peer tutoring (Fantuzzo et al., 1989) and that they can gain more self-confidence in their learning (Anderson et al., 2000). These empirical findings on peer tutoring offer support to theoretical claims that peer tutoring can have positive effects on both tutees and tutors. Tutees could benefit from a more active involvement in their learning process, more participation and faster response times (Greenwood et al., 1990). Advantages for tutors would be the stimulation of meta-cognitive skills and various cognitive processes (Hartman, 1990).

2.2.2 Forms of peer tutoring

There are many different forms of peer tutoring, both in the kind of tutoring being given (e.g. instruction or question-answering) as well as the kind of peers being selected to act as tutor. Peer tutoring groups may be same-age or cross-age, small or large, fixed or reciprocal, face-to-face or online, and preliminarily trained or not (De Smet, 2008). In a literature review of the field of peer tutoring, Topping (1996) distinguishes nine varieties of peer tutoring with differing results in terms of effectiveness on elements such as knowledge gain, achievement and stress:

1. <u>Cross-year small group tutoring</u>. This is the form of peer tutoring where upper year students act as tutors to lower year students. Each tutor simultaneously tutors a small group of tutees. Based on the literature available, this form of peer tutoring appears to be the most common form. The majority of the research on student achievement shows that this form of peer tutoring is as good as or better than group tutoring by a teacher. Furthermore students are generally positive about it.
2. <u>The Personalised System of Instruction</u>. Students are working on programmed learning material at their own pace. The role of the peer tutor is to check, test and record the progress and to ensure the tutee's mastery of each step. The vast majority of the studies on this form of peer tutoring found that it increases student performance, compared to various control groups. Furthermore it had a positive influence on retention of learning material.
3. <u>Supplemental instruction</u>. In this scenario, tutors do not directly

address curriculum content, but have the role of advisor and facilitator instead. Tutors have completed the tutee's course at hand, and usually join the tutee again in attending lectures. Positive results with this form of peer tutoring have been found in terms of the impact on course grades, graduation outcomes and dropout rates.

4. Same-year dyadic fixed-role tutoring. The tutoring is taking place between pairs (dyads) who are at the same point in their studies. The roles of tutor and tutee are fixed. The research on this form of peer tutoring has been of mixed quality and has resulted in mixed outcomes.
5. Same-year dyadic reciprocal peer tutoring. The tutoring is taking place between pairs (dyads) who are at the same point in their studies. The students can be both tutee and tutor; the nature of the tutoring role is reciprocal. The vast majority of the studies on this form of peer tutoring found increased attainment, reduced student stress and improved transferable skills.
6. Dyadic cross-year fixed-role peer tutoring. The tutoring is taking place between pairs (dyads), of which the tutee is a lower year student and the tutor is a upper year student. The roles of tutor and tutee are fixed. Topping only found studies of poor quality.
7. Same-year group tutoring. Studies on same-year group tutoring mostly report on a format of rotating presentations by students to their peers. Students generally have a positive attitude towards this form of peer tutoring, but no evidence was found on achievement.
8. Peer-assisted writing. In this scenario, peer tutors give feedback on written products or the writing process fellow-students. A number of studies in which peer-assisted writing resulted in an increased writing competence. Furthermore, students generally have a positive attitude towards it.
9. Peer-assisted distance learning. Peer-assisted distance learning can have various forms such as occasional summer schools or the use of teleconferencing. There is little evidence that this form of peer tutoring improves achievement.

2.2.3 Reciprocal peer support

When asked to list critical – in this case meaning important as well as time-consuming - tutoring activities, a group of teachers at two Dutch Universities considered the answering of students' questions as a critical yet time-consuming aspect of a teachers' task (De Vries et al., 2005). Several researchers have explored whether peers could take over the task of answering student questions from teachers when teacher support is not immediately available or in settings in which there are no teachers present. Sloep (2008) for example proposes ‘ad-hoc transient communities’ as a model for peer support. These are communities that emerge from a larger community for a specific purpose such as a support request by a learner. After the purpose has been achieved, the community disappears. In this model, as researched by among others Van Rosmalen et al. (2008) and Westera et al. (2009), students can be both tutor and tutee and this role shifts depending on whether they ask a question or are selected to act as peer tutor. Based on the above considerations, the focus of this dissertation is on a form of peer tutoring which resembles Topping’s (1996) ‘same-year dyadic reciprocal peer tutoring’ most, as well as Ten Cate, Tromp & Cornwall’s (1984) description of ‘teacherless group education’. In our view, this is a form that potentially can decrease the teacher’s tutoring load most, since as stated previously teachers indicate that the answering of student questions is specifically time-consuming (De Vries et al., 2005. A specific characteristic however is that it always originates from a student’s question regarding his learning. We will therefore refer to this form of peer tutoring as ‘reciprocal peer support’. In this form of support peers act as tutors who answer fellow-students’ questions the latter have while studying. For example, when student A does not understand a certain concept he is studying, he asks student B (who is studying the same material) for help. At the same time, student B can ask a question, which is then answered by student C, etc. Figure 2.1 shows a diagrammatic representation of reciprocal peer support, in which the circles are the students. The arrows between all students refer to the reciprocal element, and the black & white colour in the circles represents the roles of both teacher (tutor) and student (tutee) a student can have in this approach.

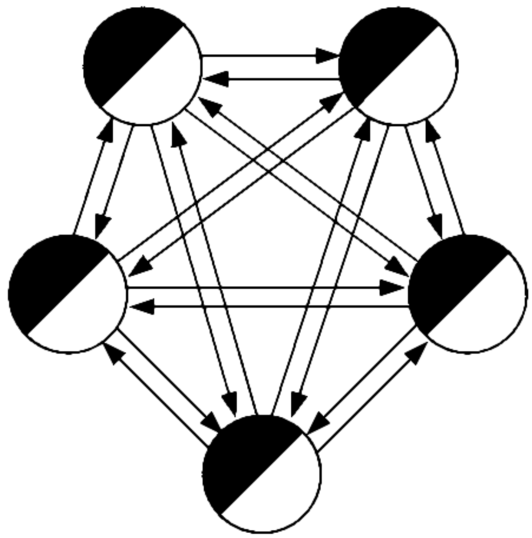

Figure 2.1: *Diagrammatic representation of reciprocal peer support (after Ten Cate et al., 1984)*

As some of the studies in this dissertation show, students are already seeking help from fellow-students (De Bakker et al., 2007). For this they have several tools available. Most Virtual Learning Environments (VLEs) used by educational institutions make peer support available via a discussion board. Students can post the questions they have regarding their learning on an online board. Fellow-students can read these posts and answer them. Students themselves also use instant messaging (De Bakker et al., 2007) for help-seeking from peers. Both these technologies are characterised by self-regulation, in which peer selection is organised bottom-up. Self-regulation of peer selection introduces some possible organisational problems. In the case of bulletin boards for example there is not guarantee that the question poser receives a response, since it could happen that none of his fellow-learners feels obliged to answer the question or, indeed, completely fails to notice the question. It is hardly possible to use instant messaging in larger groups or groups of people that do not know each other, since students in those cases probably do not know which student to turn to with a specific question. Although, then, to some extent peer support occurs spontaneously, its efficiency if not effectiveness could be improved upon significantly. Organising peer support could make this happen.

2.3 Organising reciprocal peer support

Peer support can be organised in several ways, with differences on at least three aspects:

1. direct or mediated support;
2. synchronous or asynchronous support;
3. the number of peers.

First of all, the support can be direct or mediated. Direct in this case means in a face-to-face meeting between tutee and tutor(s). In the case of mediated support a communication technology is used to organise the support, for example a telephone or computer. Direct support can be suitable in contexts in which students already see each other regularly, for example during a lecture at University, while mediated support seems suitable for groups of learners that do not meet regularly, such as students in blended learning settings or part-time students. However, mediated support has a general advantage for both groups since it enables the support to be given independent of whether the students have face-to-face contact at all or when it is unavailable at the moment they need support. This makes it available more quickly, especially when it is organised online.

Secondly, the support can be given instantly at the moment there is a need for support from a tutee (synchronous) or can be given at a later stage (asynchronous). Timing of support is an important issue. On the one hand the support should be given fast enough for the student in need of support to be able to continue studying without much delay. On the other hand peer tutors need to be able to prepare the support to be given. Looking at online support specifically, discussion boards (in VLEs) are characterised by their asynchronous nature. In the context of peer support, asynchronous communication technologies have as an advantage that they offer a peer tutor the opportunity to think over his answers thoroughly, since he is not expected to answer the question immediately. This in turn is a disadvantage for the question poser. When for example a student is stuck in studying a certain topic, he would benefit from receiving support on short notice in order to continue studying. Synchronous technologies such as instant messaging or Twitter could offer a solution here. Students, mainly the younger ones, are already using instant messaging quite extensively for online peer support (De Bakker et al., 2007). It would be worthwhile to explore its use as the main technology. This would enable online peer support to be given at a much shorter notice than is the case with asynchronous technologies such as discussion boards. Not only does this offer the opportunity to provide students with support more quickly, it is also better in

line with their world of experience (Boneva et al., 2006) in which fast communication technologies play an increasingly important role (e.g. De Haan, Van ‘t Hof & Van Est, 2006).
Finally, the number of peers selected to provide the peer support can differ. For example, in a setting of online peer support via discussion boards, the support is usually given by several peers at a time. This may improve the general quality of the support, as several tutors work on the eventual answer to a support request by a fellow-student. The support can also be given by a single tutor, which is more time-efficient for the group of peer tutors as a whole, since only one peer at a time has to act as tutor.

Table 2.1 shows examples of how peer support can be organised with combinations of choices on the above-mentioned aspects.

Table 2.1: *Organisation of peer support*

		Peers = 1	*Peers > 1*
Direct	*Synchronous*	face-to-face one-on-one	face-to-face group
	Asynchronous	face-to-face one-on-one	face-to-face group
Mediated	*Synchronous*	instant messaging / phone call	chat room
	Asynchronous	email / offline instant messaging / twitter	discussion board / wiki / twitter / blogs

2.4 Requirements for online reciprocal peer support

Based on the considerations on direct or mediated support just discussed, synchronous or asynchronous support and the number of peers, this dissertation focuses on online reciprocal peer support using instant messaging (IM) as the support medium. Any system that offers this kind of support should meet the following requirements:

1) Students’ positive attitude towards online reciprocal peer support. Students should have a sufficiently positive attitude towards online reciprocal peer support, and the way in which it is organised (e.g.

online and via instant messaging) should actually fit their support demands. In other words, the question is whether online reciprocal peer support is an appropriate support medium for students' support needs.

2) Sufficient peer competence and sustainability. The system should be able to select sufficiently competent peers for the support need at hand. Peer competence here means that selected students are expected to be able to answer the fellow-students' question, based on their competence on the topic of the question. Furthermore, a sufficient number of peers should remain willing to act as peer tutors during the period their support is needed, i.e. that the system should be sustainable.
3) Sufficient support quality. It is a requirement that peers are expected to be able to answer fellow-students' questions based on their competence, but that does not ensure that online reciprocal peer support actually results in peers' answers that are of sufficient quality for tutees to continue studying. Therefore sufficient support quality is introduced as a separate requirement. Furthermore it is important that the learning performance of students subjected to reciprocal online peer support should be high enough.

2.4.1 Requirement 1: positive attitude towards online reciprocal peer support

Online reciprocal peer support can only be a successful support conduit if students appreciate peer support in general, and via online peer support systems such as the one proposed in this dissertation specifically. Research on appreciation of peer support shows a variety of results. Two studies in problem-based learning settings showed students preferred the expertise of teachers (Schmidt et al., 1994), but at the same time they felt that peers were better at understanding their problems (Moust & Schmidt, 1995). Hart (1990) found that students in higher distance education preferred peer support slightly. These studies were, however, conducted in offline contexts. Van Rosmalen et al. (2008) found that students perceive a system for asynchronous online reciprocal peer support as useful and usable. It is an open question whether the same goes for students using a similar system supplemented with a synchronous communication technology.

2.4.2 Requirement 2: sufficient peer competence and sustainability

Perhaps the biggest problem with the currently available technologies for peer support is that of peer competence. A crucial element and possible risk in using peer support is whether the support given by peers is of sufficient quality. In self-regulated settings of reciprocal peer support it is uncertain whether the fellow-learner acting as peer is competent enough to answer the specific question, whether he knows the topic at hand sufficiently well. For example, if the peer who answers a question has not completed the course chapter that deals with the topic of the question, it could be questioned whether his answer can be of real help to the question poser. A solution to these problems could be the direct allocation of peers. In such cases, peers are allocated to a student in need for support based on their competence to act as peer tutor. Sloep's (2008) model for 'ad-hoc transient communities' is an example of a model that relies on direct allocation. Van Rosmalen et al. (2008) applied Sloep's model to the context of a group of students studying a course.

When a student had a question concerning the course, via an online application an ad-hoc transient community was created in the form of a wiki with relevant documents. Three peers were selected that should be sufficiently competent to answer the question. Competence was operationalised as among other criteria students' progress in the course, based on the idea that students who have studied a certain topic recently should be able to help others better than those who have not. The selected peers collaboratively had to write an answer to the question in the wiki, making use of the supplied documents. In their research, Van Rosmalen et al. (2008) investigated whether direct allocation of peers based on their competence had a positive influence on the quality of answers that were given. Experts' ratings of the answers given by peers showed that students were able to answer fellow-students' course-related questions sufficiently well, and that peers selected by the allocation algorithm gave better answers than peers selected at random.

Problematic in the known examples of peer allocation systems is that they need much information to ensure peer competence (Van Rosmalen et al., 2008) and/or that they need large groups of students to arrive at peer support of sufficient quality (Van Rosmalen et al., 2008; Westera, 2007). One of the aims of this dissertation is to arrive at a system for online reciprocal peer support that is lightweight yet offers students support of sufficient quality on the other hand. Lightweight in this context refers to the aim to provide a system that is based on a minimum number of assumptions about the population it is applied to (e.g. only few student data are needed for the system to be able to operate) and a minimally sized group of students that is needed by using one peer per support request.

To arrive at the best possible setup of parameters that ensures peer competence and sustainability of a system for online reciprocal peer support, it is important to explore various conditions measuring the effects of these conditions on both peer competence and sustainability (i.e. whether the system is able to provide peer support over a longer usage period because peers remain willing to help each other). Empirical testing does not offer the flexibility to do this efficiently, since only one setup at a time can be tested, and it needs quite some organisation. Simulations of models in development, for example in a virtual simulation computer environment on the other hand provide an opportunity to clarify causal relationships and interdependencies in a much more flexible manner (Gilbert & Troitzsch, 2005). In this way it is possible to examine the ideal setup of all the different parameters in a peer support system in development, before introducing it to students.

2.4.3 Requirement 3: sufficient support quality

Once the requirement of sufficient peer competence is met, it is important to check empirically whether peers in an eventual system for online reciprocal peer support actually provide support of sufficient quality. Sufficient quality here should be put in the context out of which this dissertation originates: introducing peer support as a means to decrease teachers' tutoring load. The question then is whether peers' answers are of sufficient quality to fulfil this role. Van Rosmalen et al. (2008) have shown that with online peer support, especially when peers are allocated on the basis of their competence, it is possible to have the majority of students' questions answered appropriately. 'Appropriately' here means that the answers are of sufficient quality to allow a question asker to proceed in his learning, which does not necessarily mean that their answers are complete and correct. It might also be an indicator as to where to find the answer to the question. Van Rosmalen and collegues' results pertain to a support system based on asynchronous communication. Furthermore, they did not compare answer quality of peers to that of teachers, but to a control group instead in which peers were selected at random. In the context of the adjacent field of peer tutoring, Schmidt et al. (1994) studied tutoring by peers compared to tutoring by staff over an entire study period of four years. They found that peers performed better on supportive behaviour and that they were rated higher than teacher tutors by the students who were being tutored. However, the opposite result was found as students progressed in their studies after the first year.

It is assumed that in the context of online reciprocal peer support with instant messaging, teacher support will lead to better results than peer support. However, since one of the problems out of which this dissertation originates is that of teachers faced with a high tutoring load, the most important question is whether peer support is a proper first alternative for teacher support when the latter is not available. So although the answers given by peers may not be of the same quality as those given by teachers, the question here is whether the answers are sufficiently helpful.

Little research has been done on the relationship between peer support and achievement. Assumed that the quality of support is associated with learning performance, Griffin & Griffin (1998) found positive results on test performance for students exposed to reciprocal peer support, but they compared the results to a no-treatment control group. Moust and Schmidt (1994) examined the achievement of peer-supported students to teacher-supported students and found that both groups gained equally in achievement. Greenwood et al. (1987) also found that peer-supported students performed better than teacher-supported students. Finally, Annis (1983) found that students who act as peer perform better than those who do not. All of these results were found in contexts different from that of what Topping (1996) calls same-year dyadic reciprocal peer tutoring, neither were they found in online contexts, but it is assumed they provide indications for possible outcomes for online reciprocal peer support. Research could show whether these indications actually hold.

2.5 Towards a system for online reciprocal peer support via instant messaging

Based on the above considerations this dissertation aims to arrive at a system for online peer support that is lightweight yet offers quick support on the one hand, while offering students support of sufficient quality on the other hand. To assure the quality of peers, the system will rely on allocation of peers based on their competence. To that end we propose the SAPS system (Synchronous Allocated Peer Support). Its allocation algorithm is similar to those proposed by Van Rosmalen et al. (2008) and Westera (2007). The main differences are that the SAPS system uses instant messaging as the main communication technology, that it uses a minimum amount of assumptions about the population it is applied to, and it needs fewer students to operate properly. The system will be discussed in detail in Chapter 5.

CHAPTER 3[1]

Exploring Instant Messaging as an online peer support communication medium: survey on students' current educational use and demands

Abstract

As part of an analysis of requirements for a system for online reciprocal peer support, we explored whether instant messaging (IM) could serve as a proper candidate for a synchronous communication tool to be used with such a system. IM is the term used to describe the technology through which "users can set up a list of partners who will be able to receive notes that pop up on their screens the moment one of them writes and hits the send button" (Castelluccio, 1999). While early use could be described as fun mainly, IM today is a serious communication medium. Remarkably, it seems that educational institutions have been doing very little with it, while several studies indicate that it could indeed be a valuable tool in education. In order to explore whether IM would be a suitable communication medium to use for online peer support, we wanted to gain further insights in to what extent and for what purposes students use instant messaging in their studies, as well as whether they would like to see the medium implemented in their education. Therefore a survey was administered to a group of students in higher education. This chapter reports on this study. A large majority of the participating students indicated using IM for their studies, for activities such as cooperating with fellow-students and giving each other feedback.

[1] This chapter is based on: De Bakker, G., Sloep, P., & Jochems, W. (2007). Students and instant messaging: survey on current use and demands for higher education. *ALT-J, Research in Learning Technology, 15(2)*, 143-153.

3.1 Introduction

Our research aims to propose a system for online reciprocal peer support complemented with a synchronous technology, as this enables students to get help from fellow-students on their questions more quickly than is the case with currently commonly used asynchronous technologies such as discussion boards. It has the form of an analysis of requirements to be met for such a system to lay a claim to success. The first requirement is that students should have a sufficiently positive attitude towards online reciprocal peer support, and the way in which it is organised (e.g. online) should actually fit their support demands. This particular study focus on whether instant messaging (IM) is appreciated by students as a medium for peer support activities. Instant messaging (IM) is the term used to describe the technology through which “users can set up a list of partners who will be able to receive notes that pop up on their screens the moment one of them writes and hits the send button” (Castelluccio, 1999). IM contrasts with synchronous chat, another often applied synchronous communication medium, since that is usually organised through publicly accessible chat rooms. Research indicates that especially younger students already use instant messaging quite extensively (e.g. PEW Internet, 2005; Qrius, 2005) and they do so for school work already (Grinter & Palen, 2002). In order to explore whether IM would be a suitable communication medium to use for online peer support, we wanted to gain further insights in to what extent and for what purposes students use instant messaging in their studies, as well as whether they would like to see the medium implemented in their education. Therefore a survey was administered to a group of students in higher education. This chapter reports on this study.

Grinter & Palen define IM as follows:

> “IM systems support Internet-based synchronous text chat, with point-to-point communication between users on the same system. A window is dedicated to the conversation, with messages scrolling upward and eventually out of view as the conversation ensues. IM also supports group chat, with users inviting others to join them in a specified “room.” Some systems, such as AIM and ICQ, make some chat rooms public. In some IM systems, pictures and URLs can be included in the messaging. Colors and fonts are personalizable. “Buddy” lists display information about IM cohorts. Buddies’ on-line handles (usernames) are displayed, along with indicators of activity

(usually as a function of input device use) and availability (as inferred by activity and as stated explicitly by user-specified settings). Buddies can be sorted into user-defined categories such as “friends,” “family,” “co-workers” and so forth.” (Grinter & Palen, 2002, p.21)

In this description, IM is limited to text-based communication. However, most IM systems currently offer audio and video chatting functionalities as well. Many modern IM systems also support asynchronous chat. In this case messages sent to offline users are delivered at the moment they log in. In most cases, the IM communication is handled through a software application installed on a users’ computer. The majority of this software is free. Popular messaging systems are MSN Messenger (which recently migrated to Windows Live Messenger), AOL Instant Messenger, Yahoo! Messenger, Skype, Google Talk and ICQ. This last one initiated a popularity boost among internet users in the second half of the 1990s. However, most of the current IM systems are (partly) based on an older online chat medium: Internet Relay Chat (IRC).
Dating back to the moment the first computer networks were available in the 1970s, instant messaging experienced significant growth in the late 1990s via the rapid growth of AOL’s Instant Messenger in the United States and the MSN Messenger system in Europe, both of which provided free consumer applications for instant messaging. Although it is not possible to establish the exact total number of IM users accurately, usage numbers of several IM services indicate there are currently hundreds of millions of users worldwide[2]. Most systems use their own protocol, which prevents them from being interoperable. So users with an AOL account cannot communicate with MSN users. Several attempts, for example by The Internet Engineering Task Force (IETF), to adopt a single, open, newly developed standard protocol have failed; it is only recently that Yahoo and Windows Live have opened up their protocols for each other. Interoperability will probably be one of the main challenges for IM’s lasting success.

The number of active IM users shows the success of the medium in the short period (since the late 1990s) it has been widely available to the public. Especially among teenagers, IM has become one of the most important communication means. More than 70% of today’s youth uses IM, as surveys in the United States (12-17 year olds) and the Netherlands (6-29 year olds) show (PEW Internet, 2005; Qrius, 2005). According to the American research, only 44% of adults use the medium. Furthermore, the Dutch survey showed

[2] Various sources, see: http://en.wikipedia.org/wiki/Instant_messaging

that IM shares first place with e-mail as the most popular activity for teenagers when online. The medium is used on a much more serious level than many adults might think. Through IM, teenagers communicate with their buddy friends, make appointments, date (PEW Internet, 2001), and collaborate on school tasks (Grinter & Palen, 2002). Teenagers do about everything online through IM, since “the buddy list is teens’ social world” (Boneva et al., 2006). The rising popularity of social networking websites such as Facebook and MySpace (PEW Internet, 2007), which incorporate IM functionality into their systems, makes it even easier for teenagers to meet new social contacts online.

Grinter & Palen point out that examining this development of IM usage among teenagers provides valuable insights. IM is the first and most successful form of social software that has entered into the public’s lives. Studying the way in which the younger generation uses it, teaches us about its “role in domestic ecology”. Also, the “communication habits they develop now may indicate what we can expect from them as adults” (Grinter & Palen, 2002, p.22).

The studies on IM use mentioned indicate that youth already uses the medium for educational activities. As already indicated however, education has been widely neglecting the serious medium it recently has become. For example, many schools consider instant messaging as a mere fun tool for kids in their spare time, and some even ban it from any school activity[3]. This in spite of the fact that research indicates IM could have valuable educational purposes. For example, Farmer (2005) conducted an IM experiment among students, in which they used IM to interact with each other and to collaborate on study tasks, concluding that they had a positive attitude towards the medium. A survey among students of the Syracuse University School of Information Studies in New York showed that students benefited from the use of IM as a tool for socialisation with fellow students outside lectures (Nicholson, 2002). Several studies have shown the value of the implementation of IM as an online library referencing service (Andrews, 2004; Cummings & Guerlain, 2004; Fagan, 2004; Foley, 2002; Johnson, 2004). Coniam & Wong tested IM as a tool for language proficiency training between students from different countries (Coniam & Wong, 2004), resulting in improvements in the language proficiency skills of the participating students.

[3] http://www.webwereld.nl/articles/41182/groningse-scholen-verbieden-msn--en-sms-taal (Dutch article)

Hrastinski showed that adding IM to an asynchronous distance learning course, stimulated student participation (Hrastinski, 2006).

In order to explore whether IM would be a suitable communication medium to use for online peer support, we first want to have better insights in how students currently use IM and what their wishes are for use in education. For example, if students would state that they are willing to use IM for consultation with teachers, but not for online collaboration with fellow students, we should take that into account in our medium choice.
Previously, several surveys have been conducted on IM use among youth (PEW Internet, 2005; Qrius, 2005). However, these studies did not focus on educational use. The available studies on educational IM use (Boneva et al., 2006; Farmer, 2005; Grinter & Palen, 2002; Nicholson, 2002), and the experimental studies on IM use (Andrews, 2004; Coniam & Wong, 2004; Fagan, 2004) used relatively small sample sizes or consisted of user experience and appreciation data in case of the experimental studies. A larger study therefore is needed to get a better indication of students' IM use. Such a study should also gauge students' demands for the implementation of IM as a medium for online peer support in their studies, as such data are also conspicuously lacking so far. To serve these ends a survey was conducted among students at a Dutch institution for higher education.

3.2 Method

All participants were students at the Fontys University of Applied Sciences in the Netherlands. A number of its institutes were willing to forward a request mail to their students. Participants had to fill in their institutional personal identification number at the start of questionnaire, to prevent them from completing the online form more than once (they might want to do so in order to have a better chance at winning the lottery prize made available to them for maximising the response). Eventually, 376 male and 405 female students participated. They were aged 16-57, although the majority of respondents (42%) was aged 20-22. The participants came from various studies in arts, science and humanities.

We measured students' own perception rather than examining their actual IM use. A questionnaire with mainly multiple-choice questions was set-up. The questionnaire was partially based on questionnaires used in previous studies on IM use (Boneva et al., 2006; Grinter & Palen, 2002; PEW Internet, 2001).

Specifically for the purpose of this study, questions were added on educational use and demands.
The questionnaire was published online on a separate web space of the Fontys institute's website. Students received an e-mail with an explanation of the study, and the request for completing the online form. Also, a news item was published on the institute's intranet to attract more people to the survey website. In total, approximately 4,500 students were approached. Some of these received an e-mail, which resulted in an initial response of 668 completed forms. After the news item was published on the institute's intranet website, an additional 113 responses came in, providing a total of 781 responses. Thus, the response rate was 17%. This is a fairly low percentage, which we feel is due to the non-committal way respondents were approached, but the total number of respondents is still high.

3.3 Results

The results are organised in terms of the specific aspects of IM usage we were looking for: IM use frequency patterns, technological specifications of users' environments, social aspects of IM usage, and school use. Finally, the results of the specific questions asked on students' views on educational implementation of the medium are described. In order to find out whether generation differences show different results, the data were analysed using a Pearson product moment analysis.

3.3.1 IM use frequency patterns

The survey shows that 96% of all respondents used instant messaging. In this group, 74% indicated they used IM on a (nearly) daily basis: 5-7 days a week. These data correspond to a previous Dutch IM survey (Qrius, 2005) and American survey results on internet use (PEW Internet, 2005). Female students used the medium more often than their male colleagues. It could be argued that IM use develops over time. 48% of the respondents using IM, indicated that they used the medium more often compared to the first time they used it. However, at the same time 34% used it less often.

Possible differences between disciplines were examined as well. As the disciplines were so diverse, we were only able to compare science students to the rest of the population. It was valuable to look for possible differences between these students and the rest of the population, since technological tools such as IM are at first often mainly used by technophiles, before becoming widespread among a larger public. In contrast with what people might expect however, the science students (often considered to be the technophiles compared to other students) did not use IM more intensively than the other students, as Table 3.1 shows.

Table 3.1: *IM use frequency of science students, compared to the rest of the population.*

	Percentage of science students (%)	Percentage of the rest of the population (%)
No answer	0	1
Never	3	2
Once a month	5	2
Once a week	7	5
2 – 4 days a week	15	16
5 – 7 days a week	69	73
Do not know	1	1

Instant messaging usually is being used in between other computer activities (65%). When taking the time for it, only 24% chats longer than one hour. Also, most participants indicated that on an average day they do not talk to more that 10 people (95%). The majority of the communication is done in separate conversations; only 3% of the respondents stated they used the group conversation functionality in their IM system regularly. It can be argued that IM is characterised by short sessions and a fragmented use throughout the day.

Although the questionnaire had options for respondents to note that they were not using IM at all, very few (8%) did.

3.3.2 Technological specifications of users' environments

In the Netherlands, instant messaging is often being referred to as 'MSN-ing', since MSN Messenger/Windows Live Messenger is the most popular service in the country. The survey results confirm this, 99% of the IM using respondents uses this messaging system. Almost a quarter of all students (24%) also use Skype. Other less frequently used systems include ICQ, Google Talk, IRC, AIM (the most used system in the United States) and Yahoo messenger. Mac users also mentioned iChat, Adium and GAIM, all of which are multi-protocol applications, i.e. through these applications users can use several IM protocols instead of a single service.

When asked about their computer facilities, students indicated to have the following hardware: headset (40%), webcam (58%), microphone (53%) and speakers (92%). However, the availability of hardware does not mean that it is actually being used for IM purposes. The majority of respondents mainly use text chatting. Voice and video chat are being used 'sometimes' by 33% and 44% respectively, and more than half of the respondents use either 'never'.

Two places are most popular for using IM: at home on a students' personal computer (78%) and in school (69%). Other places are at home on a shared computer (42%), at friends (18%), or at work (11%). Only 8% of the students use IM on a mobile device.

3.3.3 Social aspects of IM usage

Most students have quite an extensive buddy list (IM contact list). A third of all students have more than 100 friends in their messenger list. Also, people who use IM more regularly have a larger contact list. Although these are impressive figures, Boyd (2006) argues these online friends have a different status than real-life friends. A large number of students (36%) indicated however that they would have a hard time missing the availability of instant messaging.

Students tend to use the medium rather freely when dealing with contacts is concerned. 68% of all respondents have ignored messages in the past, and 88% has even blocked contacts in their buddy list (making it impossible for those contacts to see or talk to them).

Conversation topics are very diverse. Table 3.2 shows the survey conversation topic categories and the percentage of participants using them.

Table 3.2: *IM conversation topics (excluding educational use) and Dutch higher education students using them (%).*

Talking casually to family and friends seen rarely	82
Talking casually to family and friends seen often	82
Making appointments with family and friends	77
Discussions with family and friends	28
Playing games	16
Discussing things you do not dare to tell face-to-face	14
Starting or ending relationships	8
Other	5

3.3.4 School use and students' views on educational implementation of IM

The majority of students (89%) used IM for one or more study activities. 67% even used it for five or more of the study activities mentioned in the questionnaire. When asked if the students wanted IM to be implemented in their education, most students (86%) indicated they wanted to use IM in their education. Almost half of the students mentioned more than five activities they would like to see in educational IM. Table 3.3 shows the educational IM activities mentioned in the survey and the percentages of students using them already personally. The last column represents the percentage of students that would like to see these activities being implemented in their education.

Table 3.3: *Educational IM activities and demands of Dutch higher education students.*

	Percentage using personally (%)	Percentage would like to see implemented (%)
Discussing school tasks with fellow students	85	85
Sharing files (such as report concepts or sketches)	71	74
Cooperating on school tasks with fellow students	63	76
Discussing course material with fellow students	61	59
Gathering content, such as course material	44	55
Reflecting on fellow students' work	36	45
Teacher guidance	1	34
Other	-	1

Differences between actual and desired use are small, with the exception of teacher guidance.

3.3.5 Generation differences

The age of the respondents ranged from 16 to 57, but the largest group was 19-21 years old (43% of the respondents). The survey showed some interesting correlations between certain aspects of IM use and demands, and the age of the respondents. We will limit ourselves to describing only the correlations that proved significant ($\alpha<0.01$). In general, younger students are more intensive IM users. They used the medium more often than the older

students (r = -.389), had more buddies (r = -.429) and used it when connected to the internet more often (r = -.283). Also, they talked to more people in one day (r = -.326). When looking at technology use (i.e. use of audio/video), we did not find a significant effect of age. However, younger students tend to replace text-based messaging by audio and video alternatives somewhat more (r = -.205). When asked if the respondent would like to make more use of IM, it turned out that the older students were more interested in doing so (r = .194).
On the educational use of the medium, we did not find major differences between ages. Educational demands did show some interesting differences. In general, a larger number of the younger students would like to see an educational implementation of IM in the future. 4 out of the 9 categories of educational IM use students could chose from for indicating their use for those purposes, showed a negative correlation with age. Those categories were 'discussing school tasks with fellow students', 'cooperating on school tasks with fellow students', 'gathering content, such as course material', and 'sharing files (such as report concepts or sketches)'. Also, the option 'I do not want to use IM in my study' showed a modest positive correlation (r = .152), which indicates that older students are less willing to use the medium for educational purposes. When looking at the activities more specifically, the younger students would like to have more task discussions (r = -.100), collaboration (r = -.101), information gathering (r = -.116), and file-sharing (r = -.142) through IM.

3.4 Conclusions and discussion

The survey in this chapter explored students' current use of IM and their demands for educational implementation, in order to find out whether IM could be a suitable medium for online peer support. Before drawing a conclusion on this question, some of the findings will be reflected upon here.

In general, people who make more use of instant messaging, also use it longer, have a larger buddy list (IM contacts), etc. Thus, the adoption wave does not seem to concentrate on specific aspects of IM usage. Perhaps one of the most interesting findings of this study is that younger students use instant messaging more intensively than their older peers. Younger students are also keener on trying new possibilities of the medium. The age group should therefore be taken into account when one aims to use IM for educational purposes. It also indicates that the adoption of the medium is still developing.

Therefore it would be interesting to see how this development continues. Will IM become the primary communication medium for everybody? A Dutch youth survey shows this is already the case for a certain age group (Qrius, 2005). It could also be that age plays a big role in the adoption of the medium. It might be a youth tool people tend to grow out of. A question that can only be answered as the current IM generation grows older. Looking at the recent corporate IM implementation wave, and the indicated usefulness of the medium in business contexts (Nardi, Whittaker & Bradner, 2000), the latter it is not to be expected (Pauleen & Yoong, 2001; Perry, et al., 2001).

The fact that only a small percentage of respondents indicated not to use IM at all prompts the question whether IM users are more than proportionally present among the respondents (selection bias). As it is to be expected that people who actually use the medium already respond differently than those who do not, one should only carefully extrapolate results to the entire population. This issue should be taken into account in future research. Other surveys however, which used respondent approaching procedures that guaranteed a more balanced population, show similar IM use figures (Qrius, 2005). A survey specifically on IM use in the United States showed lower use frequency percentages (PEW Internet, 2004), but this used an adult sample only.

The fact that only one-third of the population indicates they would like to see teacher guidance being available via IM, should be considered in implementation of the medium. This might indicate that students prefer getting support from students when they ask for it via IM.

Above all, the survey shows that although education has been neglecting the possibilities for educational use of IM, students are already using the medium to cooperate on school tasks, give each other feedback, etc. Today’s students embrace the medium, and would like to see it being implemented in their learning environment. Therefore, we believe that IM answers to the first requirement for an online peer support system, as students except it as a medium for online peer support. IM is known to students already and it enables them get their support more quickly than is the case with peer support via asynchronous tools (such as discussion boards) which are more common at the moment.

CHAPTER 4[4]

Towards a system for online reciprocal peer support via instant messaging: a pilot study

Abstract

In recent decades, both society and (higher) education have changed. Particularly in the wake of social-constructivist theories, many institutes have transformed their teaching approach to a model in which students are involved in different activities at different moments. Thus, student populations are becoming more heterogeneous. For example, they have different tutoring needs. This leads to an increasing workload for teachers. At the same time, students have changed in their expectations. A young generation of students, who grew up with ICT embedded in their daily lives, have become used to the almost instant availability of knowledge and accessibility of people through the internet. Online reciprocal peer support is indicated to be a promising first alternative for teacher guidance when that is unavailable. A crucial element in its success however, is students' attitude towards peer support. To examine this attitude, an online peer support system was made available to two groups of students in a pilot study. A selection of students was selected to participate in interviews, providing data on the feasibility and acceptance of this form of peer support. The interview data indicate that students are positive towards online reciprocal peer support, but that the context in which it is implemented is crucial.

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[4] Parts of this chapter are based on: Westera, W., De Bakker, G., & Wagemans, L. (2009) Self-Arrangement of Fleeting Student Pairs: a Web 2.0 Approach for Peer Tutoring, *Interactive Learning Environments, 17(4)*, 341-349.

4.1 Introduction

Our research is aimed at developing a system for online reciprocal peer support. It has the form of an analysis of requirements to be met for such a system to lay a claim to success. The focus of this particular study is on the first requirement of our requirements analysis, being that students should have a positive attitude towards online reciprocal peer support, and the way in which it is organised (e.g. online and via instant messaging). This should actually fit their support demands. In order to investigate students' attitude towards online reciprocal peer support, two pilot studies were done with a prototype version of such a system to gain some first insights in the feasibility of such a support system and the acceptance among students.

4.1.1 Allocation

The prototype built for allocated peer support was partly based on a matching mechanism proposed by Westera (2007). In his PAIR (Peer Allocated Instant Response) system, peers are selected based on their tutor competence following an allocation algorithm, similar to other allocation algorithms such as that by Van Rosmalen et al. (2008). In the peer support systems based on those algorithms, students are appointed the peer tutor role for a specific question, based on one or more student variables that are used to define his peer competence (i.e. his competence to act as peer for a specific question). Westera proposes a particular method of setting up peer support based on progression data of students within a course or curriculum, which has a fixed set of learning tasks, course units, modules, etc. Progression data here means data on each student's progress in for example the modules of a course, such as module completion date and time. As opposed to more complex algorithms which use various data types, Westera's algorithms only looks at student progress in the course or curriculum to determine a student's tutor competence, and thus does not need more complex identification of domain knowledge or content itself. Figure 4.1 below shows a schematic representation of the PAIR algorithm. When a student has a question on a certain element of the course or curriculum, an algorithm tries to identify a competent peer tutor by selecting fellow-students who are currently working on the same learning tasks/course units/modules (parameter 3) or who have recently completed it (parameter 4). Furthermore, the algorithm contains extra parameters such as economy principles to evenly distribute the tutor load among the student population (parameters 6 and 7), and parameters to exclude recent tutors and self-tutoring. When the algorithm fails to find a suitable peer based on its selection criteria, the question is forwarded to the teacher (parameter 5). There are various options for gathering navigational data. Students can be asked for example to complete a short test at the end of each learning unit (course module, task, etc.), or they can be asked to keep track of their progress themselves. Both options are labour-intensive in traditional non-online settings for the teacher, the student, or both. A virtual learning environment could automate these processes, thus making the gathering of navigational data much less labour-intensive.

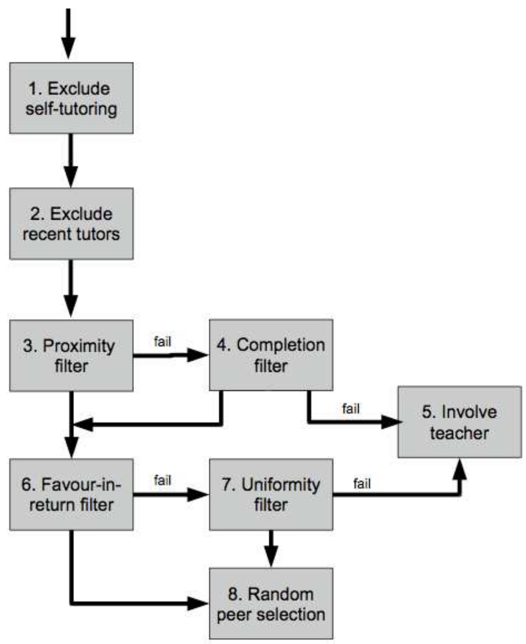

Figure 4.1: *Schematic representation of the PAIR algorithm.*

4.1.2 The prototype

A software prototype for PAIR was developed that used an allocation mechanism based on Westera's algorithm, complemented with an instant messaging (IM) service to arrange the contact between students and their peers. The instant messaging service offered both online and offline chat, similar to the technology found in mainstream IM services such as Windows Live Messenger and Skype. Since both the pilot courses were taught using course books, the application consisted of a tool via which students had to actively keep track of their course progress (the survey method mentioned above). Figure 4.2 shows a screen shot of the software prototype.

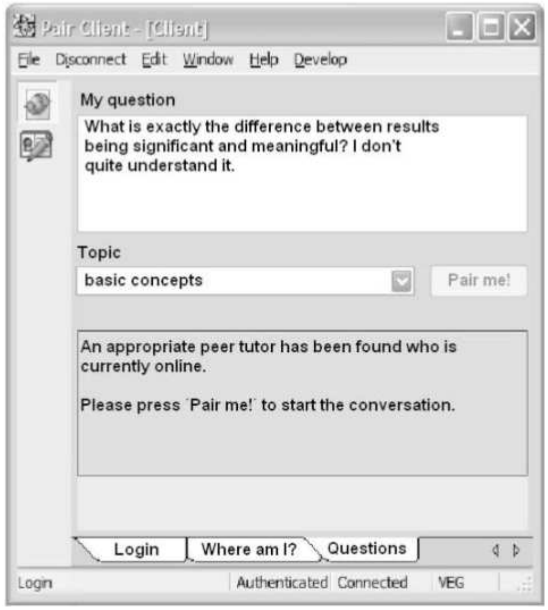

Figure 4.2: *Screenshot of the PAIR prototype application.*

To explore the possibilities of a system for allocated peer support via instant messaging a pilot study was conducted in which two groups of students used the PAIR peer support system for the questions they had during a course. Some of the participants in the pilots were selected for partaking in interviews to get initial data on the feasibility of an online peer support system. For determining the feasibility, three aspects were focused upon. First of all, the aim was to find out how students appreciated the general *concept* of a system for allocated synchronous peer support. The second aspect focused on was if there were any *technical issues* with the system that the research team itself had not yet found in the logging data, and students' *technical preferences* concerning receiving support. The third focus was on *contextual aspects* of this specific pilot implementation that might influence the usage of the system, such as course type. Furthermore we were interested in the user-friendliness, efficiency and effectiveness of the system as appreciated by the students. Here we describe the results of the interviews.

4.2 Method

A group of 104 distance students at the Open University of the Netherlands, aged between 25 and 55, had an initial version of the system available for questions they had on a Statistics course in their study of Psychology. With the teacher it was agreed that contact with the teacher was only allowed through the system. If the matching mechanism did not provide a competent fellow-student, the question was forwarded to the teacher via an email sent from the system. At the same time, a group of 20 ICT students in face-to-face education at the Fontys University of Applied Sciences, aged between 19-21 had the opportunity to work with the system. This group is of additional interest, since it consists of students who are educated to become ICT specialists and already have significant software development skills. The system was available to both groups in the form of an application on their own computers.

After completion of the course, a number of the participating students were asked to participate in interviews aimed at finding out the reasons for using or not using the system, and under which conditions the students would use a similar system in the future. The interviews asked question about conceptual, contextual and technical factors, and had a semi-structured approach to leave enough space for aspects that might not have been included into the questions set-up in advance. The students were selected from several categories, ranging from those who initially were willing to participate in using the system, but eventually did not use it, to those who used the system regularly (see Table 4.1).

Table 4.1: *participation figures of students in the course, based on logging data of the system.*

	Open University (nr. of students)	**Fontys** (nr. of students)
Initial interest, but no participation	63	10
Initial install of the application, but not making use of it eventually	22	9
Having asked questions, but did not receive any response	15	1
Having initiated interactions, based on questions asked via the system	4	0
TOTAL	**104**	**20**

The actual selection of interview participants was based on an equal division of participants from the user categories (having asked questions, having initiated sessions, etc.) shown in Table 4.1 in order to get a balanced picture. In total, 12 students from the Open University pilot and six from the Fontys pilot were interviewed. The comments by the 18 students interviewed were categorised into the three main topics of this study: conceptual, technical and contextual. Additionally, some questions were asked on the user-friendliness, efficiency and effectiveness of the system to those few students who actually used it. Each interview took approximately 30 minutes. The students' comments from the interviews were categorised by the research team into the previously described categories *concept*, *technical issues/preferences*, and *contextual aspects*.

Complementary to the interviews, an email was sent to the distance students at the Open University (see Table 4.1): those who initially indicated to be interested in participating in the pilot, but eventually did not install or use the system. In this mail, students were asked to briefly state the reason(s) for not participating after all. These reasons were logged into the same categories as those from the interviews, namely conceptual, technical and conceptual reasons. Finally the logging data of the system were used to analyse usage frequencies and the way in which students used the system.

4.3 Results

The results of the interviews will be discussed for each category of participants' comments. Due to technical issues in the testing phase, the software was available to the OU students only after they had been working on the pilot course for a month already, for the remaining two months of the course period. This might have negatively influenced the OU students' attitude towards the software prototype or online peer support in general. The Fontys students did not suffer this release delay.

Regarding the concept of online peer support, most students judged a peer support system using instant messaging such as the one presented to them during the course as a convenient way for helping each other. When they felt they were competent enough to answer questions on a specific topic, they were willing to do so, if that would not interfere with their own studying too much. Many students, both in the Open University and the Fontys pilot, felt the system lacked the feeling of the availability of personal contact. The application did not sufficiently give them the feeling that other students were online, since the only time they noticed other online students was once a successful match occurred. This feeling eventually made them choose for more traditional and trusted communication media such as e-mail or the telephone for their tutoring needs, since in their opinion these provide a more direct feeling of personal contact.

Looking at the technical aspects of the software prototype, most interviewees indicated that the current application was transparent, easy to use and well designed, just as they demand such an application to be. It has to be clear from the start where to find all basic functions of the system. The thorough documentation provided to the students at the start of the pilot might have helped in this matter. Some students indicated they could not get the system to work, for example due to firewall problems. When they were not able to fix the problem at short notice, most of them stopped trying. It is therefore crucial to monitor at the start if all students manage to get the application running on their computers.

Regarding the context of the pilot, students indicated that the pilot course did not produce many questions for which the system could be used, since the course was practical in nature and therefore many of their questions could be answered simply by looking them up (online). The students also stated they still had many other, more familiar options available for asking questions. For example, the course teacher still responded to emails of students who did not use the peer support system and he was available at special periodic study meetings, although he agreed not to do so. Students indicated they preferred these two options to using the system, since those options were more familiar. This was aggravated by the problem that when students asked questions, the small number of participating students resulted in the allocation mechanism mostly not being able to find a peer tutor, so the students indicated. The logging data of the system and students' comments showed also that when the system did provide a peer tutor, but one that was not online at the very moment, students in most cases terminated the request instead of choosing the option of contacting the tutor via the asynchronous offline mode, something that was found in a later study as well (De Bakker et al., 2010b). Another interesting aspect mentioned by the students in the Fontys pilot was that, if they studied in small groups (in their case a class of 20 students), they knew most of their fellow-students and knew as well which student had knowledge of a specific topic. So in their opinion allocation systems like the one used in the pilot would not be needed to find a suitable peer tutor. However, some of the Fontys students indicated a system like the one used in the pilot could be valuable if it enabled them to contact senior students, since they sometimes feel reluctant to contact them directly, while they believe they could learn from them. Students indicated that actively keeping track of their study progress, which they had to do in this version of the application, was too much extra work, especially during the last course period prior to the exam. For the Fontys students, the very notion of keeping track of your progress made no sense as they were inclined to complete the majority of the course parts just before the course deadline.

34 of the 63 contacted students responded to our email. Their answers provided some valuable clues for the low number of students eventually participating in the distance pilot. Many students indicated that this was due to personal circumstances, which was therefore added as an extra category. Students could freely provide their reasons (one or more) for not using the PAIR system. From their replies, a variety of reasons was collected. Table 4.2 provides an overview of all the reasons stated, with the number of times they were mentioned.

Table 4.2: *Reasons for not using the system after initial interest.*

Conceptual reasons	**+ times mentioned**	**Technical reasons**	**+ times mentioned**	**Contextual reasons**	**+ times mentioned**	**Personal reasons**	**+ times mentioned**
I do not study using my computer often	2	I could not install the application at my work computer	1	I could post my questions on the bulletin board available for this course	2	My study is currently paused due to personal circumstances	18
I do not see value in help from fellow students	1	My anti-virus program blocked the application	1	I could ask my questions in the face-to-face study meetings	2	I was already completing the course when the application became available	4
		I could not install the application on my computer	1	I did not have many questions on the course material	1		
		The software is not available on Mac computers	1	The course material was fairly easy, which would result in spending to much time on working with the application proportionally	1		

4.4 Conclusions and discussion

To get a first idea of the feasibility of a system for online peer support via instant messaging, a prototype of such a system was tested in a pilot study. The findings will be discussed per aspect focused upon in the interviews.

On the conceptual level, the results indicate that students have a positive attitude towards online reciprocal peer support if other more traditional ways to have their support needs fulfilled are not thought to be better. Also, they are willing to help each other in such a support context. The lack of the feeling of availability of peer tutors is also an important barrier. Our findings on this aspect are in line with Nardi et al. (2000), who found that employees in a work environment find it reassuring to know that there are other people around. Our findings indicate that the “perceptible affordances” (Gaver, 1991) of the availability of peers in the software prototype are not in line with the actual affordances; they are what he calls “hidden affordances”. Or, following Norman (1990), there are real affordances in the system that do not reveal themselves. The perceptible affordances to stimulate the feeling that there are fellow-students available in an online peer support system should be enhanced, for example by incorporating social presence tools, such as proposed by Kreijns (2004). His Group Awareness Widgets (GAWs) are small software tools to stimulate the feeling of social presence of peers. In our system, those could be used to stimulate the sense of availability of help from peers. They could look like an information box within the application, which shows the number of students actually being online.

Looking at technical aspects and the application specifically, it is important that the user interface of such a system is clear at first sight. Since the technology is new, students will tend to look for other alternatives for support if the system is ambiguous in what it is supposed to offer. Furthermore, a situation in which students’ progress is kept track of automatically, for example via a VLE, is preferred over a situation in which students have to do that themselves.

The context in which online peer support is implemented is important. Not surprisingly, the interview data show that the setting in which allocated peer support could be successful, is one in which it provides benefits for students’ tutoring needs additional to the benefits they already receive from other opportunities for support. In contexts in which students already have various other options for finding support, such as the availability of face-to-face study meetings, which are more efficient to them, direct allocation of peer tutors might therefore not be needed. The results of the pilot in the setting of face-to-face education show that allocated peer support is less likely to succeed among a small student group. Students know each other and have knowledge of each other’s specific knowledge or competence; so direct allocation is not beneficial for students in such a case. We do however believe that in groups larger than the student population in the experiment (20 students), peer support may be beneficial in face-to-face education as well. Since even in those contexts learning takes place independent of place and time ever more support needs are likely to arise outside the lectures as well. Also, direct allocation with more senior students or students from other institutions may work in such contexts. In distance education, where students of this particular study indicate they do not have sufficient and efficient ways of contacting other students, direct allocation could be a valuable solution to get students in contact with each other in order to fulfil their support needs.

The setting in which a system based on Westera's allocation algorithm would be implemented will need large groups of participating students in order for the allocation mechanism to be able to provide enough successful matches. Westera (2007) conducted a simulation study that indicated that his mechanism operated ideally (i.e. was able to provide a sufficient amount of successful matches) in groups with no fewer than approximately 100 people. Probably the main reason is that the algorithm's parameters work towards exclusion. If a peer candidate does not meet up to a parameter's criterion, he is excluded as peer. Also, in smaller groups too often the same duo is being selected for giving each other support, a possibility that the algorithm excludes due to its economy principles. These specifications restrict the currently used allocation mechanism's applicability. So, in order to arrive at a system for peer support that is able to cope with a variety of group sizes, a first step would be to come up with an allocation algorithm that is able to cope with smaller student groups, by altering its parameters and possibly adding some extra allocation features.

To conclude, an online reciprocal peer support system via IM could be a successful support tool since students generally would appreciate it if it is applied in the right context in which alternatives to acquire support are not thought to be better. Also, to be able to serve smaller populations than the required 100 with the algorithm used, a new allocation algorithm capable of coping with smaller student populations is needed.

4.5 Acknowledgements

The software used in this study was developed with help of the SURF foundation, in the PAIR project of the Open University of the Netherlands and Fontys University of Applied Sciences.

CHAPTER 5[5]

Introducing the SAPS system and a corresponding allocation mechanism for synchronous online reciprocal peer support activities

Abstract

While student populations in higher education are becoming more heterogeneous, recently several attempts have been made to introduce online peer support to decrease the tutor load of teachers. We propose a system that facilitates synchronous online reciprocal peer support activities for ad hoc student questions: the Synchronous Allocated Peer Support (SAPS) system. Via this system, students with questions during their learning are allocated to competent fellow-students for answering. The system is designed for reciprocal peer support activities among a group of students who are working on the same fixed modular material every student has to finish, such as courses with separate chapters. As part of a requirement analysis of online reciprocal peer support to succeed, this chapter is focused on the second requirement of peer competence and sustainability of our system. Therefore a study was conducted with a simulation of a SAPS-based allocation mechanism in the NetLogo simulation environment and focuses on the required minimum population size, the effect of the addition of extra allocation parameters or disabling others on the mechanism's effectiveness, and peer tutor load spread in various conditions and its influence on the mechanism's effectiveness. The simulation shows that our allocation mechanism should be able to facilitate online peer support activities among groups of students. The allocation mechanism holds over time and a sufficient number of students are willing and competent to answer fellow-students' questions. Also, fine-tuning the parameters (e.g. extra selection criteria) of the allocation mechanism further enhances its effectiveness.

[5] Based on: De Bakker, G., Van Bruggen, J., Sloep, P., Jochems, W. (in press). Introducing the SAPS system and a corresponding allocation mechanism for synchronous online reciprocal peer support activities. *Journal of Artificial Societies and Social Simulation.*

5.1 Introduction

Society and (higher) education have changed rapidly in recent decades. The digital revolution has had its influence on the educational process (Sloep & Jochems, 2007). For example, students can learn more independent of place and time today. Higher education itself has been subject of change in the last decade as well. Many institutes have transformed their learning approach to one in which students have more control over their own learning process. As a result student populations are less homogeneous, students being increasingly involved in different activities. This leads to increasing tutoring needs, which has had a negative effect on teacher workload (Fox & MacKeogh, 2003; Rumble, 2001). Most of the tutoring today is in the hands of teachers. However, several researchers have explored whether students could take over (parts of) teachers' tutoring tasks by acting as peer tutors. Not only could this reduce teachers' tutoring load, it also has some additional advantages. Peer tutoring could have a positive effect on the learning process and knowledge construction (Fantuzzo et al., 1989; Gyanani & Pahuja, 1995; King et al., 1998; Wong et al., 2003). For example, Fantuzzo et al. (1989) found higher learning outcomes and more social interaction in a peer tutoring setting, as compared to several control groups such as a group that received video-based instruction, which they argue was caused by the element of structured exchange between students subjected to the peer tutoring. Tutors themselves also benefit from tutoring others (Fantuzzo, et al., 1989), a phenomenon known as the self-explanation effect (Ainsworth & Loizou, 2003; Chi et al., 1994). Other studies found that peer tutoring stimulates interactions leading to knowledge construction (Gyanani & Pahuja, 1995; Slavin, 1995), that students become more motivated (Fantuzzo et al., 1989), and that they can gain more self-confidence in their learning (Anderson et al., 2000).

Teachers indicate the answering of student questions is specifically time-consuming (De Vries et al., 2005). A problem however in using peers to act as tutors for students' questions is selecting peers who are sufficiently competent to answer a specific question. Attempts have been made to make this process more efficient, by introducing systems for online reciprocal peer support (e.g. Van Rosmalen et al., 2006; Sloep et al., 2007). In these cases, questions students have while studying are answered by fellow-students acting as peer tutors via computer applications (De Bakker et al., 2008) or web services (Van Rosmalen et al., 2008). Reciprocal here means that students can be both tutee and tutor, but they can also be one or none of the two. Especially in distance education, such systems to facilitate peer support activities with intervened peer allocation could be beneficial, since students are more isolated and more often do not know which fellow-student to turn to with their questions. Many higher education institutes have introduced forms of peer support over the last few years. Perhaps the most common implementation is that of a bulletin board or web forum, via which students can post their questions. Other students who log on to the bulletin board can read and answer these questions. This is a method in which peer allocation is self-regulated without the intervention of a facilitating allocation system. Although this seems appropriate in many cases, there are definite benefits to mediated peer support based on direct allocation of peers to answer questions, some of which are pointed out by Westera (2007): a) someone gets the responsibility to offer the support, b) the likelihood of support becoming available is increased, c) allocation results in the selection of the most competent peer tutor, d) the time before getting an answer can be reduced, e) peer tutor load can be distributed more evenly over the population. Field experiments with peer support systems with intervened peer allocation as described have shown promising results in terms of user appreciation and effectiveness. For example, Van Rosmalen et al. (2008) found that the majority of students working with such a system were positive towards it and that the majority of students' questions was answered sufficiently according to experts who rated the answers given by peers. Similar previous initiatives for online peer support systems have some important drawbacks. They are either only suitable for larger populations (Westera, 2007) or, if the support is given asynchronously, confront tutees with a waiting time (Van Rosmalen et al., 2006). To develop an online reciprocal peer support system that is suitable for smaller population sizes and that provides students with support more quickly, we introduce the SAPS system (Synchronous Allocated Peer Support). This system connects students with study questions to peers. The support is given via instant messaging (IM). Our research is based on an analysis of requirements online reciprocal peer support systems should meet. As part of that, this study is focused on the requirement of sufficient peer competence and sustainability. Such a system should be able to allocate sufficiently competent peers for the support need at hand. Peer competence here means that students are expected to be able to answer fellow-students' questions, based on their competence on the topic of the question. Furthermore, a sufficient number of peers should remain willing to act as peer tutors during the period their support is needed, i.e. that the system should be sustainable.

The current study focuses on this requirement as it was tested via a model of the SAPS system in a simulation study using the NetLogo simulation environment (Wilensky, 1999). First however, the new system will be described.

5.2 The SAPS system

The SAPS system is designed for reciprocal peer support activities among a group of students who are working on the same fixed and stand-alone modular material every student has to finish, such as courses with separate chapters.

5.2.1 Selection quality: tutor competence

Analogous to existing peer allocation systems (e.g. Van Rosmalen et al., 2006; Westera, 2007), the SAPS system in the first place determines a candidate peer's competence by looking at 'proximity'. Students who are working on the same learning unit (e.g. learning task, course unit, module) or who have recently completed it are prioritised as candidate tutors for answering a question on that learning unit, since they are expected to be able to answer questions on the content of the learning unit. As opposed to other systems, SAPS aims to enhance the general competence of peer tutors by introducing two more selection criteria which could be implemented in the allocation algorithm for determining peer tutor competence: 'question type' and 'previous result'. Question types can be 'theoretical questions', 'organisational questions', etc. 'Question type' could be used to prioritise candidate peers who have indicated to be competent in the question type asked for by the student who has a question. Through 'previous result', the algorithm takes into account marks students acquired on learning material on similar topics, such as previous courses. This could be used to prioritise students with high marks on those topics.

5.2.2 Economy principles

To prevent some tutors (e.g. those with the highest pace) to be selected too often, following Westera (2007) the SAPS allocation mechanism consists of two economy principles that are used to spread the peer tutor load evenly among the student population. The first economy principle prioritises those students who have previously had few tutor turns ('uniformity'), the second prioritises those students who have already asked many questions themselves ('favour-in-return'). The economy principles therefore act as a kind of mediated version of a tit-for-tat mechanism expected to be crucial in cooperativeness in social peer interaction (e.g. Sloep, 2008).

A final selection criterion is ‘online/offline’. The SAPS system has been developed to be used with both synchronous and asynchronous communication media (e.g. via instant messaging). Via ‘online/offline’ candidate peer tutors who are being online (synchronous) or offline (asynchronous) can be prioritised. The current implementation of the system is mainly focused on synchronous communication to speed up the process of answering questions.

5.2.3 Selection procedure: ranking

For each of the above criteria peer candidates (i.e. all students except for the student asking a question) are given allocation points. Proximity for example is calculated as follows: a student working on the same learning unit as the learning unit the asking student is working on is given 10 points. A student who is one learning unit further gets 9 points, etc. The allocation points given on all selection criteria result in a total score of a candidate peer tutor. The candidate with the highest score is selected as peer tutor and receives an invitation. If the selected peer tutor does not respond to the request, the student with the second highest score is selected. The SAPS system has the ability to assign variable weights to all selection criteria to give more or less priority to them. Due to this ranking procedure it is possible that peers are selected with a score of 0 on all of the three quality selection criteria (‘proximity’, ‘question type’ and ‘previous result’), which in practice would mean that the peer would not be competent enough to answer a question. The number of cases in which this occurs is essential to the success of the system and is therefore a main focus of the simulation study.

5.2.4 Willingness to answer questions

Another essential aspect in the effectiveness of a peer allocation mechanism such as one based on the SAPS system, is students’ lasting willingness to answer each other’s questions. If, in the long run, none of the students would be willing enough, the system is doomed to failure. Students’ willingness is therefore an important variable within the simulation, which will be further detailed in next sections.

Figure 5.1 shows a schematic representation the SAPS system, displaying the activity sequence from question to peer-support session, as well as the allocation procedure and criteria used for matching students for the peer support activities. Additional to the quality and economy selection criteria, the selection procedure consists of two more parameters. If the ranking procedure leads to more students with the same highest ranking one is randomly selected; also each student asking a question is excluded from the list of candidate peer tutors.

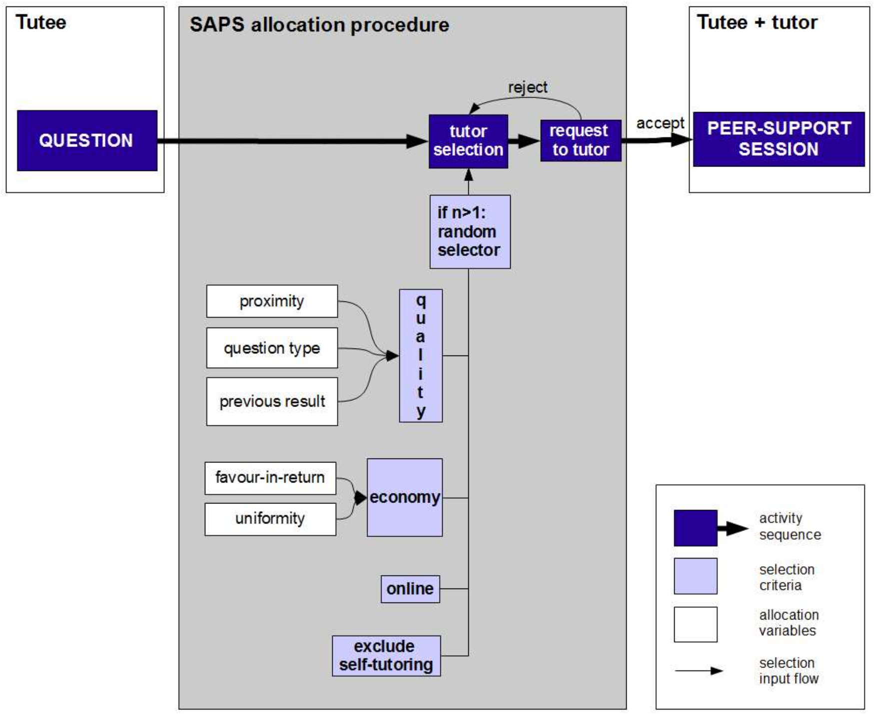

Figure 5.1: *Schematic representation of the SAPS system.*

To test the peer competence and sustainability of the SAPS peer allocation system we built a simulation model of a SAPS-based allocation mechanism. Simulations offer the possibility to adjust systems developed and to test the effectiveness of improved versions before testing or implementing them in practice. We chose to model the mechanism in the NetLogo simulation environment (Wilensky, 1999). NetLogo is especially suitable for modelling complex systems that develop over time, and analysing the connection between micro-level interaction behaviour of the agents (e.g. students) in the model and the macro-level patterns that emerge from these interactions. Furthermore, simulations offer the opportunity to examine behavioural patterns without having the limitations of contextual factors empirical studies can suffer from, such as working with real students (e.g. you cannot test the system at different population sizes within a short period of time).

5.3 Research questions

As part of our requirement analysis for online reciprocal peer support to succeed, this study focused on our second requirement: peer competence and sustainability. The main question was whether the mechanism was actually able to allocate sufficient peer tutors to students with questions based on the SAPS allocation algorithm that were sufficiently competent to do so, and whether peers remained willing to help others over a longer usage period. Furthermore, we had four additional research questions, all of which are aimed at further enhancing the mechanism's effectiveness.

1. *What is the minimum required population size at which a sufficient number of competent peer tutors are found who are also willing to answer?* The study starts with a version of the SAPS mechanism in which only 'proximity' is used to select peer students, since this is the starting point of many of such systems. As stated previously, the selection procedure could result in a peer being selected with a score of 0 on 'proximity' as well as in a situation in which questions remain unanswered because none of the fellow-students is willing to provide an answer. This is assumed to happen in a number of all selection procedures executed within the model. In an empirical study with an online peer allocation mechanism, Van Rosmalen (2008) found that approximately 9% of all questions remained unanswered. Following this outcome, we consider a maximum of 10% of unanswered questions as acceptable. Van Rosmalen also found that 25% of the questions were not solved correctly (as rated by external experts). However, since even high-quality peers (i.e. scoring high on 'proximity') might not give correct answers, we treated a lower threshold of 10% for the percentage of low-quality peers as acceptable, in line with our threshold for unanswered questions. Also, we expect that both percentages decrease when the number of students is increased, since the more students are available to act as peer, the less low-quality and unwilling peers there will be. We also expect there is a minimum population size that yields acceptable results on both.

2. *Does the introduction of extra quality selection criteria lead to an increased quality of the selection mechanism?* In the SAPS system we introduced 'question type' and 'previous result' as extra quality selection criteria in the allocation process in order to enhance the general selection quality of the mechanism. We expected that the introduction of 'question type' leads to a decrease of the percentage of low-quality peers being selected. Since the introduction of these criteria introduces extra staff work (e.g. preferred question types need to be collected), we were interested in how big this difference exactly would be. In other words, we wanted to find out whether the expected quality gain is worth the extra effort. We believe this quality gain should be minimally 10% (i.e. a decrease by the same amount of the percentage of low-quality peers being selected).
3. *In what way does omitting the economy principles from the mechanism influence tutor load spread?* Many peer allocation mechanisms have economy principles incorporated (e.g. Van Rosmalen et al., 2006; Westera, 2007). These could be useful to prevent overloading individual peer tutors. It could be questioned, however, whether economy principles are always wanted. For example, while implementing a SAPS-like mechanism among a student population, it might turn out that only a particular fraction of the population is enthusiastic about it and motivated to help each other regularly. Then only a percentage of the entire student population is actively involved in peer support activities. In such a case it would be counter-productive to apply economy principles, since these principles result in involving non-active students and the unnecessary application of load levelling on highly motivated peer tutors. Also, since students themselves benefit from acting as peer tutors (Fantuzzo et al., 1989), incorporating study load levelling would rob motivated students from the opportunity to improve themselves. We therefore wanted to ensure that omitting the economy principles from the allocation mechanism would not lead to an unacceptable overload of individual peer tutors. It would be unacceptable when omitting the principles would show a large spread of tutor turns among students, compared to a condition in which the economy principles are applied. We think an increase of less than 50% of the maximum of tutor turns in a condition in which the economy

principles are disabled compared to one in which they are enabled would be acceptable.

4. *In what way does disabling the economy principles influence the percentage of low-quality peers?* Another benefit of omitting the economy principles is that the selection procedure is focused more on the quality criteria, so this would introduce another chance to further enhance the general selection quality of the allocation algorithm. The economy principles consist of two selection criteria with the same weight as the quality selection. As the mechanism concentrates on just competence without these principles we expected a decrease of the percentage of low-quality peers being selected. Since omitting the economy principles would not cost extra effort, any quality gain would be desirable (under the assumption that omitting the economy principles would not lead to a large spread in tutor turns).

5.4 The simulation model

5.4.1 Model variables, relations, formulas and their implementation within the simulation

After the introduction of the SAPS system and the most important aspects to be focussed upon in the study, we will now describe the simulation model of an environment with a SAPS-based allocation mechanism we developed to examine our research questions. The simulation model takes into account learner profiles of all students (which can be both tutee and tutor), learning units students are studying, and questions they are asking. When asking questions, students are matched to other students based on their own and the other students' study progress and some additional variables via a tutor selection procedure. For a detailed description of all procedures see the next paragraph. Table 5.1 presents an overview of all variables, relations, formulas and their implementation within the simulation. Some variables are related by formulas and are further detailed in table 5.2.

Table 5.1: *Overview of variables and their implementation within the simulation.*

VARIABLE	DESCRIPTION	IMPLEMENTATION IN SIMULATION		INPUT FOR
		Range (initialization)	Formula	
LEARNER PROFILES				
General characteristics				
available study time	The study time a student has in a certain period.	M = 1.5 hours/week, SD = 0.5 hours (Normally-distributed)	no	progress
constraints	Fatigue, flow, stress, a.s.o.	[-0.5, 0, 0.5] (Randomized) for each time unit	no	progress
prior knowledge	Prior knowledge of a specific LU	[0, 0.33, 0.66, 1]	no	progress
progress (in a learning unit)	Progress of a student within a module.	[0 - 6.75] hours	yes	current LU, question corresponding LU
question trigger	Determines whether a question will be asked.	Boolean	yes	tutor selection, question status, nr of tutee turns
Question & answer profile				
inclination to ask questions	the general tendency of students to ask questions	Integer [1, 2, 3]	no	question trigger
willingness to help	The willingness of students to help fellow-students with their questions.	Rational [0 - 5]	yes	tutor selection

VARIABLE	DESCRIPTION	IMPLEMENTATION IN SIMULATION		INPUT FOR
		Range (initialization)	Formula	
nr of tutee turns	The number of times a student has had the rol of tutee.	Integer [0 - ...]	no	favour-in-return
nr of tutor turns	The number of times a student has had the rol of tutor.	Integer [0 - ...]	no	uniformity
Peer competence profile				
current LU	The LU the student is working on.	Integer [1, x]. The model used in in the experiment runs consisted of 20 LUs.	no	quality criterion: proximity
preferred question type	The question type(s) the student is competent in.	One or more integers from [1, 2, 3, 4, 5]	no	quality criterion: question type
previous result	The mean mark students received for past exams.	Integer [1 - 10]	no	quality criterion: previous result
login status	Describes whether the student is logged on to the system.	Boolean	no	login status check

VARIABLE	DESCRIPTION	IMPLEMENTATION IN SIMULATION		INPUT FOR
		Range (initialization)	Formula	
LEARNING UNIT				
LU size	The time needed to study the LU.	Fixed value of 6.75 hours for each LU.	no	progress in a learning unit
LU complexity	The complexity level of the LU for each individual learner.	[1, 2, 3, 4] (Randomized) for each learner at each LU	no	question trigger
QUESTION				
question corresponding LU	The LU the question corresponds to.	Integer [1 - 10]	no	quality criterion: proximity
question type	The question type asked for by the tutee.	Integer [0 - 10]	no	quality criterion: question type
question status	Describes whether a question is answered or remains unanswered.	Boolean	no	-

Table 5.2: *Formulas and descriptions for all variables that are changed through formulas by other values in the simulation.*

VARIABLE name	DESCRIPTION	FORMULA IN SIMULATION	INPUT FOR
progress in a learning unit	Progress of a student within a module that describes likeliness of transition to a next module.	Progress = previous progress state + available study time + constraints + prior knowledge	current LU, question corresponding LU
willingness to help	The willingness of students to help fellow-students with their questions.	IF willingness of student < 3, add 0.33 to his willingness. This procedure is executed at each time interval.	tutor selection
question trigger	Determines whether a question will be asked.	question trigger = (inclination to ask questions) + (LU complexity) > 4 and random [0,1]	tutor selection, question status, nr of tutee turns

The standard unit of time within the simulation is 1 day. Each student has a *Learner Profile* consisting of *General Characteristics*, a *Question & Answer Profile* and a *Peer Competence Profile*. The *General Characteristics* consist of all general parameters each student has within the simulation. *Available Study Time* is the amount of time each student has available for studying, measured per day. In the simulation, available study time is a normal distribution with a mean of 1.5 hours per day. The amount of actual studied time per day is influenced by constraints and prior knowledge. *Constraints* reflect the effect of contextual influences a student encounters while studying, which can be positive (being in a study flow), neutral or negative (e.g. suffering from fatigue or stress). Although constraints are likely to be a multi-dimensional construct, following Nadolski et al. (2009), in the simulation we simplified constraints to a unidimensional construct with possible values of -0.5, 0 or 0.5, reflecting the three possible influences described (negative, neutral, positive). *Prior Knowledge* is defined as an extra time gain a student might have on a specific learning unit because of his prior knowledge of the topic of the LU. For each LU, a student has a prior knowledge of 0, 0.33, 0.66 or 1. The number of possible values chosen provided sufficient variation of prior knowledge among the population. Each student has a certain *Progress* in a learning unit he is currently studying, which is the result of the sum of available study time, constraints and prior knowledge. Each student has a *Question Trigger* that determines at each time unit within the simulation whether he will ask a question. A student's *Question & Answer Profile* consists of his inclination to ask questions, willingness to help and his number of tutee and tutor turns. Each student has a general *Inclination to Ask Questions* set as a random integer (1, 2 or 3) at the start of the simulation, reflecting the differences between students in the need they have to ask questions while studying. After some test runs with the simulation model, three possible values were found to be sufficient to provide sufficient variation among the population and at the same time to result in a number of questions being asked in the simulation runs that was acceptable. *Willingness to Help* is a general parameter independent of who is asking a question. It is set at a general value at the start of the simulation, ranging from 0 to 5, but is a variable during the simulation when a student has answered a question. We treated willingness as a much more fine-grained variable by giving it more possible values to arrive at sufficient variation among the population and at the same time to arrive at acceptable percentages of students being willing to answer questions reflecting empirical results found in similar conditions (Van Rosmalen et al., 2008). Each student's *Peer Competence* profile consists of the current LU he is studying, his preferred question type, his previous result and his login status. Each student has a *Preferred Question type*, which is set as a parameter at the start of the simulation via one or more random integers ranging from 0 to 5. A student's *Previous result* reflects the mark a student has acquired on a similar set of learning units (e.g. a previous course), and is set as a random value at the start of the simulation with a mean of 7. *Login Status* reflects at each time unit whether a student is logged into to the peer support system, set randomly as a Boolean at each time unit. Each *Learning Unit* (LU) consists of a fixed *LU Size* of 6.75 hours and a *LU Complexity* that is student-specific and set randomly for each student at the start of studying each LU at a value ranging from 1 to 4. Each *Question* belongs to a *Corresponding Learning Unit*, depending on the LU a student is currently studying. Furthermore it has a specific *Question type*, which is set at random when a question is asked, and it has a *Question Status*.

5.4.2 Processes

In the simulation three main processes take place: studying, question asking and tutor selection. Note that the eventual peer support itself is not part of this simulation, since it only concentrates on the mechanism for peer allocation.

- Studying: at each time unit each student follows the study procedure, which is defined within the simulation as progress within a learning unit. At each time unit a student's progress within the LU he is currently studying is increased based on the following formula:

  progress(i,t) = progress(i,t-1) + st(i) + cs(i) + pk(i)

  in which:

  progress(i,t) = the current progress status of student i
  st(i) = the available study time of i
  cs(i) = the constraints of i at t
  pk(i) = the prior knowledge of i for the current LU

  If progress(i,t) >= LU size, a student proceeds to the next LU.
- Question asking: at each time unit students can ask questions. Whether they do so, depends on the following procedure: if (ask(i) + LUcomp(i) > 4) and a random Boolean procedure results in true, then student i asks a question. In this procedure ask(i) is a student's general inclination to ask questions and LUcomp(i) is the LU complexity of the current LU for student i. When a question is asked, the model determines which LU the question is about based on the current LU student i is studying, and a question type is allocated to the question. Then the procedure tutor selection is executed.
- Tutor selection: in the tutor selection procedure the following steps are taken:
  - For each student except for the student asking a question their candidate score is computed based on the SAPS algorithm. With six selection criteria in the current model, this is computed as follows:

    $$score(i) = (s_1(i) * w_1) + (s_2(i) * w_2) + (s_3(i) * w_3) + (s_4(i) * w_4) + (s_5(i) * w_5) + (s_6(i) * w_6)$$

    in which:

    $s_j(i)$ = the selection criterion j for student i
    w_j = the weight for selection criterion j in the current simulation run
  - A list is produced with students that have a willingness of 3 or more, reflecting those students who would actually be willing to answer the question.
  - From this list, the student with the highest candidate score is chosen as peer tutor. If this list remains empty, the question remains unanswered.

    Normally students' willingness to accept a question would be checked as he receives an invitation to answer a question *after* being selected as tutor. For model simplification this is now treated in opposite order, but we assume that that would lead to the same results.

- o The willingness of the selected peer tutor is decreased by 1, simulating a dead time in which a tutor is not willing to answer new questions. Following that, at each time unit the willingness of a student with a willingness of less than 1 is increased by 0.25.

Figure 5.2 shows the interface section of the SAPS model in the NetLogo simulation environment.

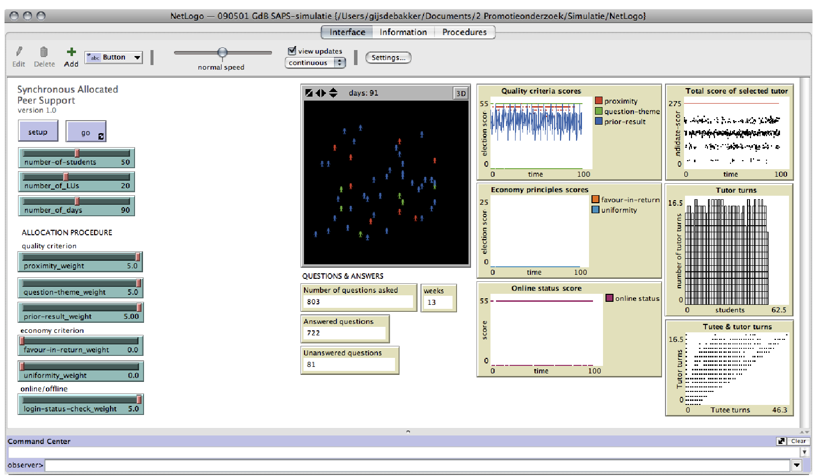

Figure 5.2: *Interface section of the SAPS NetLogo model.*

5.5 The study

In our study we conducted simulation runs with various parameter and variable values in the simulation model to test how the model reacts under various conditions following our expectations. In order to achieve sufficient stability in the results found, we replicated our simulation conditions in several runs to correct for measurement errors. We used an empirical method to arrive at the number of runs needed for this study. A random variable was chosen and the mean value of it was compared between various population sizes at an increasing number of runs. Above 100 runs no significant differences in outcomes were measured, so we decided to use this number for each condition. Below we describe the parameter and variable values and simulation runs we executed for each research question we had. All simulation runs had fixed values for the following model parameters: 90 days, 20 learning units.

Research question 1: what is the minimum required population size at which a sufficient number of competent peer tutors are found who are also willing to answer?
Simulation runs: 500 (5 * 100) simulation runs with the following parameter values for population size: 10, 25, 50, 100, 200.
Weight of all selection criteria: 5. Note that the selection criteria '*question type'* and '*previous result'* are *disabled* in this part of the study.

Research question 2: does the introduction of extra quality selection criteria lead to an increased quality of the selection mechanism?
Simulation runs: 500 (5 * 100) simulation runs with the following parameter values for population size: 10, 25, 50, 100, 200.
Weight of all selection criteria: 5. In this part of the study, the selection criteria '*question type' and 'previous result'* were *enabled*.

Research question 3: in what way does omitting the economy principles from the SAPS mechanism influence tutor load spread?
Simulation runs: 600 simulation runs with the following parameter values for the economy principles and population size: economy principles disabled/enabled, 50/500 students, 'willingness' variable enabled/disabled.
Weight of all selection criteria: 5.

Research question 4: in what way does disabling the economy principles influence the percentage of low-quality peers?
Simulation runs: 500 (5 * 100) simulation runs with the following parameter values for population size: 10, 25, 50, 100, 200.
Weight of all quality selection criteria: 5. In this part of the study, the economy principles were disabled to test their influence.

5.6 Results

5.6.1 Research question 1

In order to test the first hypothesis two analyses were conducted. We first compared the percentage of cases in which a peer was selected with a score of 0 on the selection criterion 'proximity' (i.e. a low-quality peer) in each condition (i.e. number of students in the simulation run). Figure 5.3 shows the mean percentage of low-quality peers at various population sizes, and the lower and upper bounds of the 95% confidence interval of the means found in the simulation runs. Please note that the values on the x-axis are represented on a logarithmic scale, as they are in all next result figures.

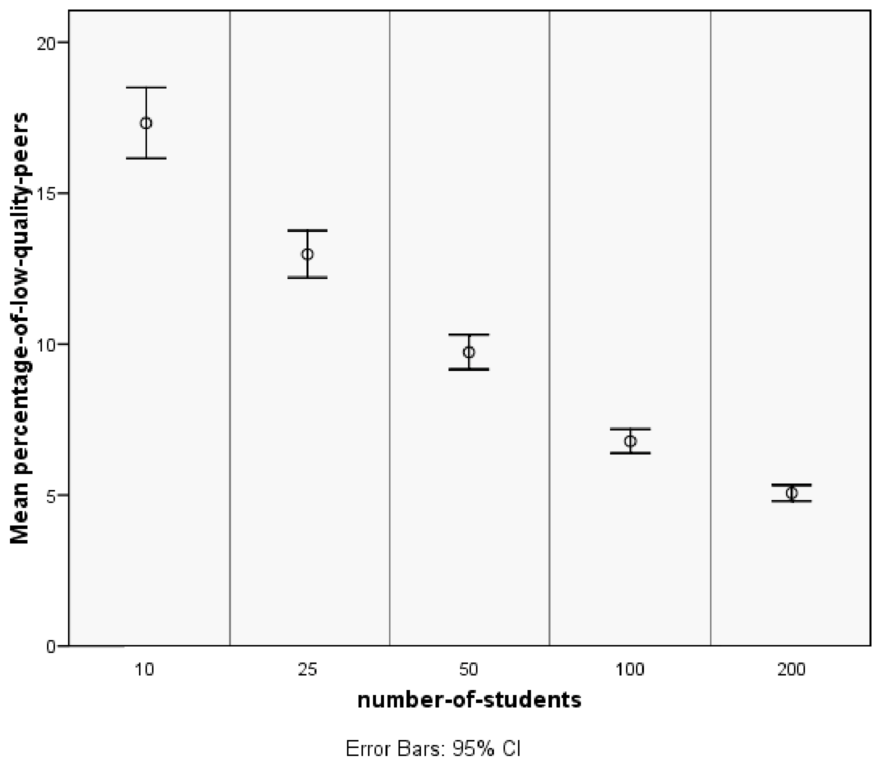

Figure 5.3: *Mean percentage of low-quality peers at various population sizes and their confidence interval.*

The results indicate that, as expected, the percentage of low-quality peers decreases when larger population sizes are used, ranging from 17.3% at a population of 10 students to 5% at a population size of 200. The confidence intervals of the means show that the criterion of no more than 10% of the questions being answered by low-quality peers is reached by population sizes slightly larger than 50 students.

As the quality of the selection mechanism also depends on peers' willingness, we compared the percentage of questions that remained unanswered in each condition due to lack of willingness among the population to answer questions. Figure 5.4 shows the mean percentage of unanswered questions in each condition.

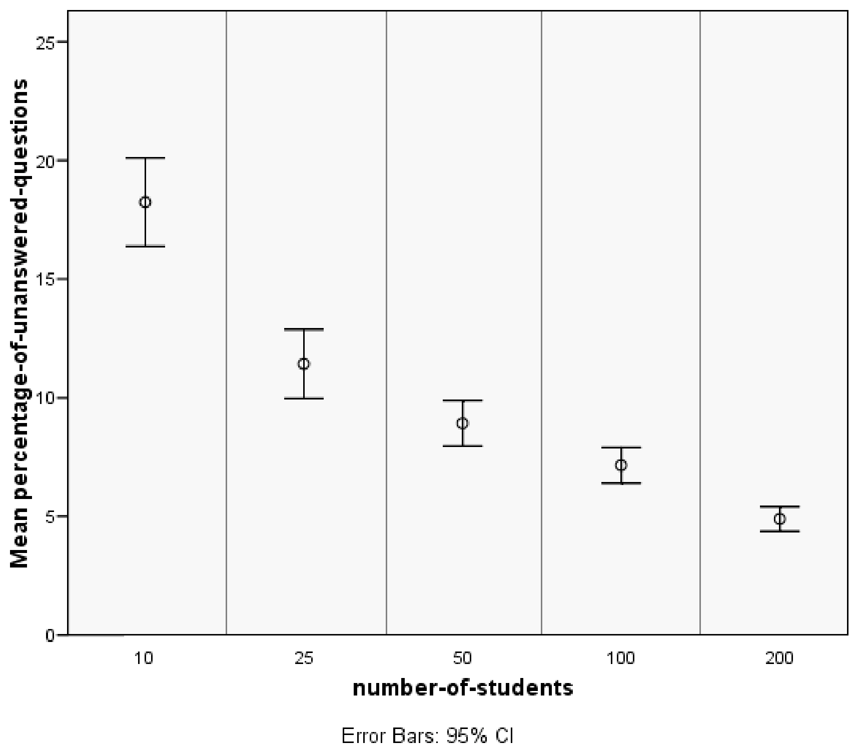

Figure 5.4: *Mean percentage of unanswered questions at various population sizes and their confidence interval.*

The results indicate that the percentage of unanswered questions decreases when larger population sizes are used, ranging from 18.2% at a population of 10 students to less than 5% at a population size of 200. When taking into account a 95% confidence interval of the means found in the simulation runs, we see that the upper bound of this interval is below 10% from 50 students or up. In other words, the model shows acceptable results with student populations of 50 students. The following tests are aimed to increase the model's effectiveness by further enhancing the outcomes.

5.6.2 Research question 2

To test whether the introduction of extra selection criteria would enhance the selection quality of the model leading to more competent tutors being selected, we added 'question type' and 'previous result' as extra selection criteria (i.e. they were given the same weight (5) as the other selection criteria in the mechanism). Figure 5.5 shows the mean percentage of low-quality peers in simulation runs with the extra selection criteria enabled in the mechanism.

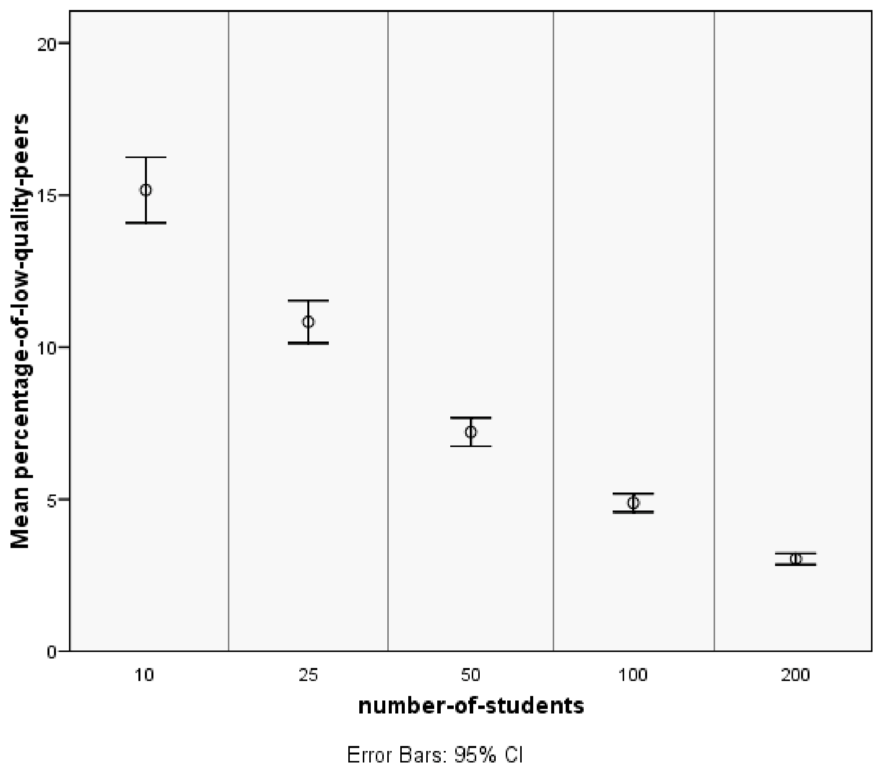

Figure 5.5: *Mean percentage of low-quality peers at various population sizes and their confidence interval in simulation runs with extra selection criteria enabled.*

The percentage of low-quality peers decreases when larger population sizes are used, ranging from 15.2% at a population of 10 students to 3% at a population size of 200. The data showed that with the added criteria, the mean percentage of low-quality peers being selected is generally lower than in conditions in which only 'proximity' is used as a quality selection criterion, as shown in table 5.3. The mean difference is 2.2%, which is equal to 24.7% less low-quality peers when the extra selection criteria are enabled. At the same population size as the first part of the study, 50 students, the mean percentage of low-quality peers has decreased form 9.7% to 7.2%.

Table 5.3: *Difference in mean percentage of low-quality peers at various population sizes.*

	number-of-students	**Mean percentage with extra criteria disabled**	**Mean percentage with extra criteria enabled**	**Difference**
percentage-of-low-quality-peers	*10*	17.32	15.17	2.15
	25	12.98	10.84	2.14
	50	9.74	7.16	2.58
	100	6.78	4.88	1.90
	200	5.06	3.04	2.03
			Mean difference	**2.16**

When comparing the percentage of unanswered questions, no differences were found between conditions in which the criteria were disabled or enabled. This is logical since this percentage is influenced by the 'willingness' variable in the model, which was not altered.

5.6.3 Research question 3

To test the third hypothesis, we examined the tutor load spreads in two conditions. During the first 100 runs the economy principles ('uniformity' and 'favour-in-return') were disabled, during the second 100 runs they were enabled. In both cases, the student population was made up of 50 students. Figure 5.6 shows the lowest, the highest and mean number of tutor turns of all students in both conditions.

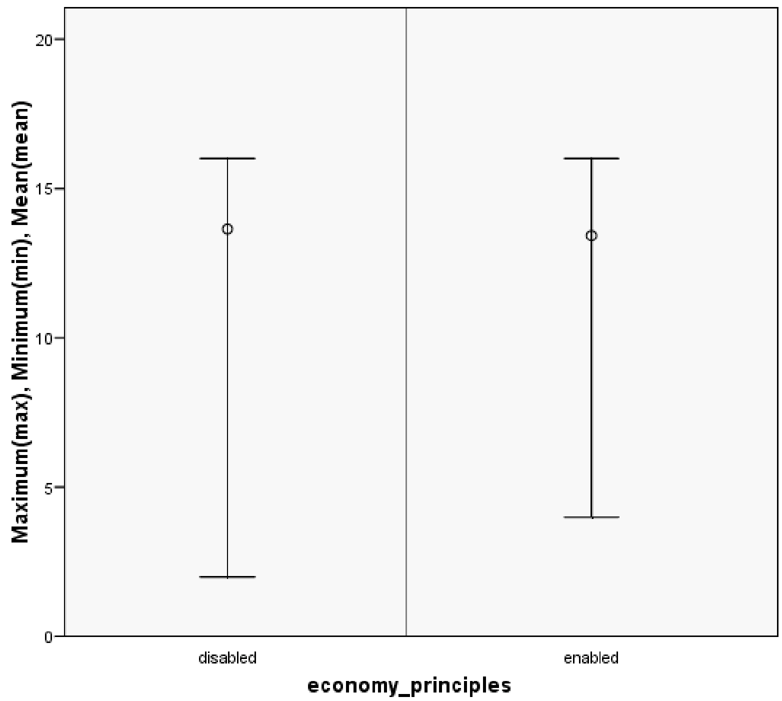

Figure 5.6: *Lowest, highest and mean number of tutor turns of all students with economy principles disabled and enabled respectively.*

The average number of questions answered in both conditions is 674. Although the mean number of tutor turns is similar in both conditions (M=14 in condition 1, M=13 in condition 2), we did find a greater spread in the number of tutor turns in the condition with the economy principles disabled compared to the condition with the principles enabled. There are more students with lower numbers of tutor turns when the economy principles are turned off and the lowest number of tutor turns found was generally lower. Although we expected the same differences to be present among the students with higher number of tutor turns, we found that the maximum number of questions answered in both conditions was 16. With a mean total of 674 questions answered that means that the maximum number of questions a student receives is equal to 2% of all questions, which is acceptable. Also, the maximum number of tutor turns is equal in both conditions. However, since the maximum of tutor turns never exceeded 16 while at the same time we found a larger spread among the students with less tutor turns, the data clearly showed a ceiling effect in the maximum number of tutor turns. After examination of the data and the simulation model we found that this effect was caused by the willingness variable. In the simulation model, after accepting a tutor request a student will not accept any new request for a short period of time; a natural tutor dead time). The effect of this variable was exacerbated by the results of a test run in which the willingness variable was disabled. In a real-life setting this would mean that every student who receives a request accepts it and answers the question. In this case, the variance in the number of tutor turns is now much greater. There are students who do not have any tutor turns, while other students are overloaded with questions, while they receive as many as 134 of all requests (20% of all questions answered). In this scenario the enabling of the economy principles does not influence these results dramatically.

To test whether larger population sizes would show other patterns in the data, we did the same procedure of 200 simulation runs with a population of 500 students. This showed results similar to those described above.

5.6.4 Research question 4

To test whether the disabling of the economy principles would lead to an extra decrease of the percentage of low-quality peers, we compared the mean percentage of these simulation runs with the results found previously. Table 5.4 shows the results combined with the results from the previous executed runs. The mean difference in percentages between the last is 10%.

Table 5.4: *Difference in mean percentage of low-quality peers at various population sizes with a) only 'proximity' enabled, b) with both 'proximity' and 'question type' enabled, and c) the same as b, but now with economy principles disabled.*

	number-of-students	**Mean percentage with extra criteria disabled**	**Mean percentage with extra criteria enabled**	**Mean percentage with economy principles disabled**
percentage-of-low-quality-peers	*10*	17.32	15.17	14.29
	25	12.98	10.84	9.79
	50	9.74	7.16	6.50
	100	6.78	4.88	3.90
	200	5.06	3.04	2.74

Figure 5.7 shows a graphical representation of the percentages of low-quality peers found in all simulation runs. It shows the quality gains achieved in each of the above-described setups of the allocation mechanism.

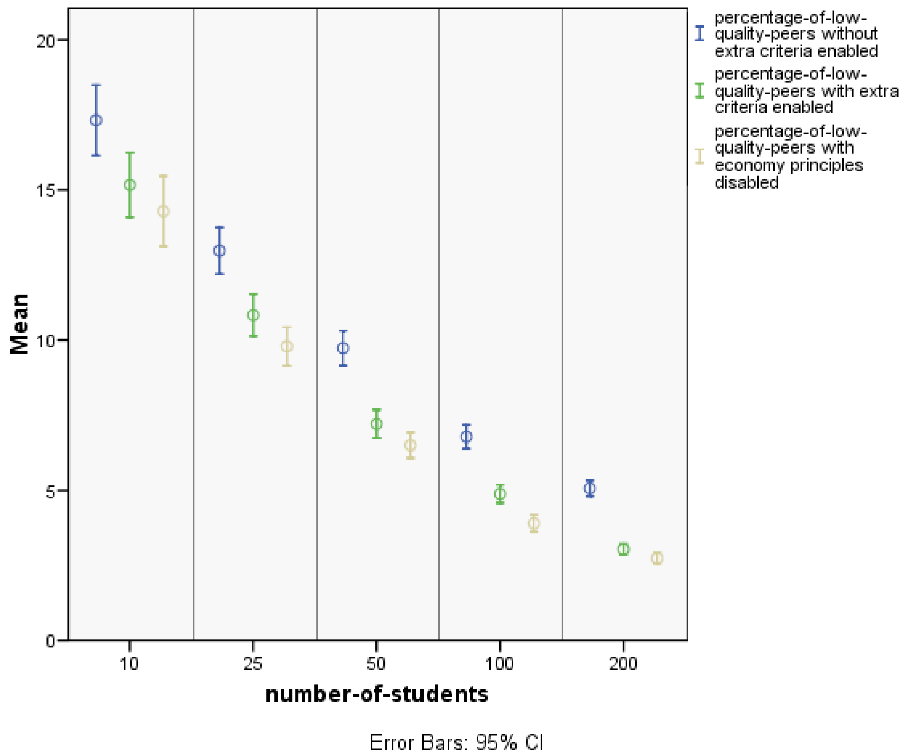

Figure 5.7: *Difference in mean percentage of low-quality peers at various population sizes with a) only 'proximity' enabled, b) with both 'proximity' and 'question type' enabled, and c) the same as b, but now with economy principles disabled.*

5.7 Conclusions & discussion

The purpose of this study was to explore the feasibility of an allocation mechanism for online reciprocal peer support activities among groups of students working on the same modular material. To improve earlier approaches we developed the Synchronous Allocated Peer Support (SAPS) system. As a first step in examining whether the allocation mechanism of our system could work in practice, this simulation study was conducted.

Quite generally, given our assumptions for the simulation model, a SAPS-based allocation mechanism should be able to facilitate online peer support activities among groups of students. The allocation mechanism holds over time and a sufficient number of students are willing and competent to answer fellow-students' questions.

A more detailed look showed that the model reacts differently to various population sizes, and the results give an indication of the minimum population size needed to achieve acceptable results. We defined acceptable as values of lower than 10% on the percentage of low-quality peers as well as the percentage of unanswered questions. In a real-life setting, this would mean that one in ten questions asked remains unanswered or is answered by a peer who has not yet completed the question-specific course unit ('proximity') or who has not indicated to be competent at providing the type of support ('question type') needed. In such cases students could repost their question at a later stage. The study showed that a SAPS-based allocation mechanism operates properly from student populations of 50 or more. However, it should be noted that the more students are added, the more effective the mechanism becomes.

The aim of the first part of the study was to arrive at a minimum required population size, the second part concentrated on the aim to further enhance the selection quality of the SAPS-based allocation mechanism. We found that introducing extra quality selection criteria increases the quality of the selection mechanism, since it decreases the percentage of low-quality peers. At the minimum required population size of 50 found previously we found that the percentage of questions that was allocated to a low-quality peer tutor decreased by 12.4%. When the number of students was increased, the difference in mean percentage of low-quality peers increased as well. We found a mean 25% decrease of low-quality peers being selected over all population sizes, far more than the 10% we expected. Therefore, we state that adding the extra criteria is recommended. It increases the chance to arrive at more competent peer tutors at fairly low cost, namely those of composing a list of common question types for a domain. This however assumes that such themes are easily defined and clear to all students when applied. Empirical testing should be able to show how this would work in practice.

In the third part of the study we found that the omission of economy principles to distribute the tutor load evenly among the population did not influence the mean number of tutor turns, but that there occurs a difference in the spread of turns. The spread only occurred in one direction; there were more students with fewer tutor turns in the condition with the economy principles disabled, but the maximum number of tutor turns was similar in both cases. Although this would mean that the acceptable maximum of 50% more tutor turns for certain peer tutors was not exceeded, we found that a ceiling effect - caused by the way in which willingness to answer questions was implemented - influenced the results. Therefore we conducted additional simulation runs with the willingness variable left out of the simulation model. This lead to an overload of some of the peer tutors, since they received 20% of all questions. However, it is to be expected that in peer support activities willingness does play a significant role, so omitting it probably decreases model validity. To prevent complexity issues in the simulation model, willingness was defined as a relatively simple construct. In practice, willingness would be a much more complex construct, with aspects such as selective willingness, tit-for-tat and time constraints likely to be of influence. While it is hard to model such complex constructs within the boundaries of a simulation model, it would be interesting to test empirically how willingness works in practice and following that, if our current conclusion that the economy principles could be omitted actually hold.

In the last part of the study we examined whether omitting economy principles from peer allocation systems would result in an extra selection quality gain. We examined whether disabling the economy principles in the SAPS-based allocation mechanism would lead to an extra decrease of the percentage of low-quality peers being selected. We argued that since omitting economy principles requires hardly any effort, a mean difference in the percentages of low-quality peers found compared to those found in the previous parts of the study would already be a sufficient gain. This turned out to be the case. We think this needs additional empirical testing. Further research could show whether this would indeed lead to having a more enthusiastic group of students who would be more willing to help each other, thus lowering the percentage of unanswered questions, and consequently lead to students being more satisfied with the answers they receive. This should however be combined with the suggested empirical research based on a more complex definition of willingness.

Another focus for future research could be to look at different contexts. For this study we limited ourselves by modelling a set of linear modular material that consisted of 20 Learning Units and had a life cycle of 90 days. Future simulations should give insights to see what influence changing these characteristics would have. For example, since we expect the student population to become much more heterogeneous as time increases (e.g. the differences in study pace increase), additional runs could show if a SAPS-based allocation mechanism would work over a longer period of time. Also, to be able to serve educational material organised in a different way, it would be valuable to examine if such a mechanism could be applied to a set of non-linear learning materials.

The SAPS allocation algorithm does not include didactic competences peers should have in order to be able to tutor fellow-students. A tutor that is competent in terms of the content of a course (e.g. by having completed the course module a tutee has a question about) does not necessarily have this competence. However, in two empirical studies we conducted we found that the majority of tutees' answers are sufficiently answered by peer tutors selected by the SAPS algorithm based on their content competence (De Bakker et al., 2010a; De Bakker et al., 2010b). Van Rosmalen et al. (2008) also found that the majority of tutees' answers were sufficiently answered by peer tutors selected via a similar allocation algorithm. In our view this is an indication of the didactical competence of peer tutors to answer fellow-students' questions.

Van Rosmalen (2008) points to the importance of the community aspect of online peer support systems. The formation of ad-hoc transient communities could be used as starting points for the formation of longer lasting communities (Fetter, Berlanga & Sloep, in press). Students in this way could be motivated to continue contact with their peers This offers them the opportunity to develop a more structural support relationship with fellow-students.

5.8 Acknowledgements

The authors would like to thank Bert van den Berg of the Open University for his consulting activities during the development of the simulation model.

CHAPTER 6

The influence of synchronous online reciprocal peer support on answer quality, test performance and student satisfaction with peer support

Abstract

While student populations in higher education are becoming more heterogeneous, resulting in a greater support demand, recently some attempts have been made to introduce online peer support to decrease the tutor load of teachers. Previously we proposed a system that facilitates synchronous online reciprocal peer support activities for ad-hoc student questions (De Bakker et al., in press): the Synchronous Allocated Peer Support (SAPS) system. Via this system, students with questions during their learning are allocated to competent fellow-students for answering, using an instant messaging tool (IM) for communication. As part of our requirements analysis for such a system, in this study we tested the third requirement: the system's effectiveness in terms of answer quality, students' learning performance and students' appreciation of such systems. To that end an empirical study was conducted with a software prototype of SAPS. The answer quality of peers was compared to that of teachers, test performance was compared between peer-supported and teacher-supported students. A survey was administered to measure students' satisfaction with online peer support systems and SAPS specifically. The study shows that, although students rated peers' answers slightly lower than teachers' answers, the majority of the peers' answers were rated positively. Experts rated teachers' answers higher than peers' answers, but the percentage of questions correctly solved by peers was still acceptable. The performance of both groups on multiple-choice tests does not differ. Finally, the majority of students perceived a system for online reciprocal peer support via instant messaging as useful and usable.

6.1 Introduction

The digital revolution, which started with the introduction of the personal computer to our homes in the 1980s, has had enormous impact on our work and social life (Sloep & Jochems, 2007), and on our education (Westera & Sloep, 2001). For example, the internet has made an increased flexibilisation in higher education possible, such as learning independent of place and time. As a result student populations are less homogenous, as students for example are studying at different moments. This leads to teachers being faced with students asking more questions, which has increased their workload (Fox & MacKeogh, 2003). Reinforcing this development is the fact that younger students use ICT regularly and expect their teachers to do the same (Prensky, 2001; Simons, 2006). Teachers indicate specifically the answering of student questions is time-consuming (De Vries et al, 2005). Previous initiatives tried to solve this problem by introducing online peer support. Unorganised forms of peer support are already widely available, via for example online discussion boards in VLEs. Possible drawbacks of these unorganised forms of peer support are that it can be unclear whether the peer who answers a question is actually fit for the job; there might be more competent peers in relation to the specific question. Also, specifically discussion boards are always asynchronous and there is a higher likelihood that questions remain unanswered if no one feels responsible to answer the question. It is difficult to foresee if and when students' questions will be answered, since no one specifically is appointed to do so.

Answering to these drawbacks, online peer support systems have been proposed that use an allocation mechanism that aims to select competent peer tutors (e.g. Van Rosmalen et al., 2006; Sloep et al., 2007). Such systems route students' questions to those fellow-students acting as peer tutors that are selected on their competence to answer specific questions (Westera, de Bakker & Wagemans, 2009; Van Rosmalen et al., 2008). Elsewhere we introduced a system that facilitates reciprocal peer support activities via instant messaging: the Synchronous Allocated Peer Support (SAPS) system (De Bakker et al., in press). It is based on a more encompassing support model for cohorts of students who work on modular learning materials (i.e. chapters, topics, etc.). Via this system, students with questions that arise their learning are allocated to competent fellow-students for answering. The SAPS system is designed for reciprocal peer support activities among a group of students working on the same and stand-alone modular material every student has to finish, such as courses with separate chapters. Furthermore, it distinguishes itself from similar initiatives by the allocation mechanism being suitable for smaller student populations and by the use of instant messaging (IM) as the main technology. Instant messaging was used since most students are already familiar with this medium in the context of helping each other on study tasks (De Bakker et al., 2007).

For each specific question a student (tutee) has, a computer algorithm selects the most competent fellow student available in the peer group to act as peer tutor. The algorithm uses the following criteria/parameters:

- Quality - proximity: looks for peer candidates currently working on or having recently completed the same modular learning material as the tutee.
- Quality – question type: looks for peer candidates who have indicated to be competent in the question type asked for by the tutee. What these questions types are depends on the context in which the system is applied, but examples would be 'theoretical questions' or 'technical support questions'.
- Quality – previous result: looks for peer candidates who have acquired high marks on e.g. courses with similar topics.
- Economy – favour-in-return: prioritises those students who have already asked relatively many questions themselves.
- Economy – uniformity: prioritises those students who have previously had few tutor turns. Economy principles are useful to prevent overload of individual peer tutors by spreading the tutor load evenly among the population.

Figure 6.1 shows the SAPS allocation algorithm displaying the activity sequence from question to peer-support chat session, as well as the allocation procedure and criteria used for matching students for the peer support activities.

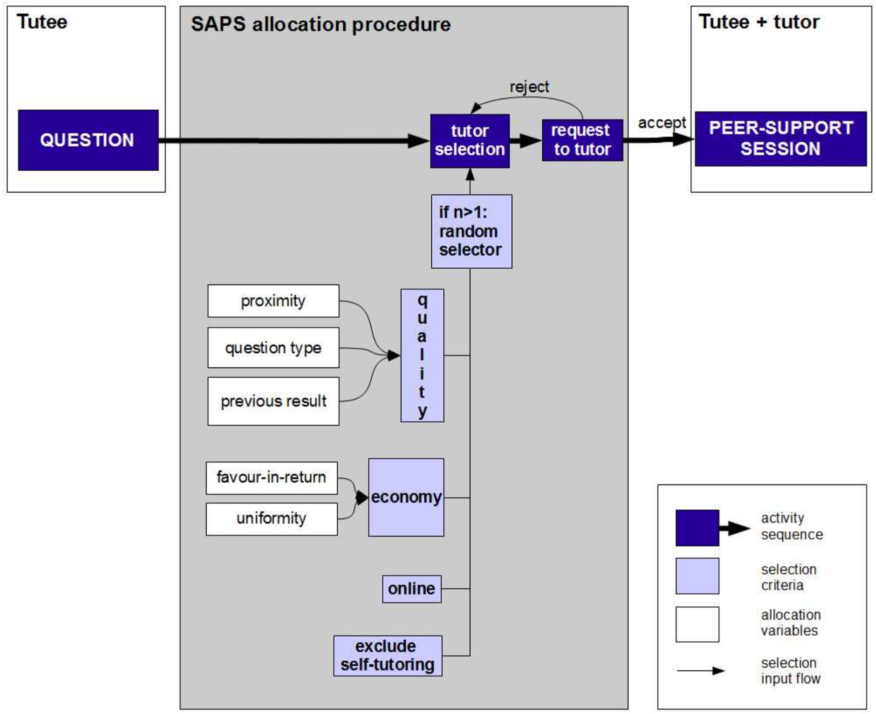

Figure 6.1: *The SAPS model.*

Any peer support system should meet requirements in order to make a claim to success. Our research has the form of an analysis of these requirements. As part of that, this study focuses on the third requirement: sufficient support quality. Online reciprocal peer support should result in peers' answers that are of sufficient quality for tutees to continue studying. Furthermore it is important that the learning performance of students subjected to reciprocal online peer support should be high enough.

6.1.1 Answer quality

The majority of research on peer support reports on influences of peer support on student satisfaction, achievement or skills of tutees. Only little research is available on the quality itself of the support given. However, if some of students' questions will not be forwarded to the teacher anymore but to fellow students instead, the question is whether the answers given by peers will indeed be of sufficient quality. In other words, the question is whether peer support is of sufficient quality as a first alternative to teacher support when that is unavailable. Schmidt et al. (1994) studied peer support versus staff support over an entire study period of four years. They found that peers performed better on supportive behaviour; peers were also rated higher than teacher tutors by the students who were being tutored. However, the opposite result was found as students progressed in their studies after the first year. In the context of online reciprocal peer support, Van Rosmalen et al. (2008) conducted an experiment with an asynchronous peer support system based on a peer-matching algorithm, in which peers' answers to fellow-students' questions on course content were rated by experts on the learning content, and found that the overall quality of peer support was good; 71% of the questions answered by peers could be marked as solved. This study however did not compare answer quality of peers to that of teachers, but to a control group instead in which peers were selected at random. Apart from an objective measure of quality, an important aspect in support is whether the students themselves perceive the support given as helpful. In the same study, Van Rosmalen et al. (2008) found that question-asking students rated the majority of the answers given by peers positively.

Due to teachers' expertise on the content of the learning material they teach, it is to be expected that teachers perform better than peers in answering questions. At the same time however, it is unlikely that teachers will be available to students' questions as often as peers can be. One of the problems out of which SAPS originated was that of teachers faced with a high tutoring load. In an attempt to solve this problem peer support for individual study questions is proposed as a first alternative for teacher support if that is not available. So although the answers given by peers may be of lower quality than those given by teachers, the issue here is whether the answers are sufficiently helpful to the question poser, for example by pointing them into the direction of the right answer.

6.1.2 Peers vs. teachers: learning performance

It is assumed that the quality of support is associated with learning performance. Little research has been done on the influence of peer support on learning outcomes. Griffin & Griffin (1998) found moderately positive results on test performance for students exposed to reciprocal peer tutoring, in comparison to a no-treatment control group. Moust and Schmidt (1994) found that peer-supported and teacher-supported student groups gained equally in achievement over a course period. Greenwood et al. (1987) found that peer-supported students perform better than teacher-supported students. Finally, Annis (1983) found that students who act as peer perform better than those who do not. These results were found in various contexts, but an important characteristic of the research described is that students were trained to act as peer tutor in most cases.

6.1.3 Student appreciation and support preference

Another important issue is how students appreciate peer support in general, and via online peer support systems such as the one proposed in this chapter specifically. Research on appreciation of peer tutoring shows a variety of results. Hart (1990) found that students in higher distance education slightly preferred peer tutoring to teacher guidance. Two studies in problem-based learning settings found varying results. One study showed students preferred the expertise of teachers (Schmidt et al., 1994), while another showed that students felt that peers were better at understanding their problems (Moust & Schmidt, 1995). None of these studies were conducted in the specific context of online reciprocal peer support. Looking at students' appreciation of online peer support specifically, Van Rosmalen et al. (2008) found that students perceive a system for asynchronous online reciprocal peer support as useful and usable.

6.2 Research questions

As peer support in this chapter is proposed as a means to decrease the tutoring load of teachers, the online peer support system's effectiveness will be examined in comparison to that of teacher guidance.

The first research question is on answer quality. Although one would assume teachers to perform better than peers, we argue that peers selected via the SAPS system's algorithm are able to sufficiently answer at least 50% of the questions. In our view the investments needed to implement a peer support system in a given situation would only be justified if peers are able to answer at least half of the students' questions when teacher support is not immediately available. Both experts and students compared the quality of the answers that were given by teachers and peers.

The second research question is on learning performance. Since little is known about student performance in the context of using peer support systems like SAPS, performance of peer-supported students will be compared to performance of teacher-supported students. We argue that the performance of the peer-supported group may not be significantly lower than that of the teacher-supported students, since this would mean that peer support leads to inferior results in terms of learning outcomes.

The last part of this chapter will focus on students' preferences for peer support or teacher support, user appreciation of peer support in general, the technologies used and of the specific system developed. Based on the findings of Schmidt et al. (1994) described previously, our expectation is that students will prefer the support of teachers.

Following the above considerations, in this experiment we tested the following hypotheses:

- At least 50% of the answers given by peer tutors selected via the SAPS algorithm are rated positively by experts. Experts will rate answers given by teachers higher than those of peers.
- At least 50% of the answers given by peer tutors selected via the SAPS algorithm are rated positively by students. Students will rate answers given by teachers higher than those of peers.
- The performance on multiple-choice tests of peer-supported students is not significantly lower than that of teacher-supported students.
- Students prefer teacher support over peer support.
- Students perceive (a system for) online synchronous reciprocal peer support as being useful and usable.

6.3 Method

In order to investigate the effectiveness of the SAPS system a version was developed that was based on an earlier prototype of an online peer support system (Westera et al., 2009). The new prototype implemented the SAPS peer-matching algorithm. Although a previously held simulation study indicated that leaving the economy criteria (i.e. parameters for distributing the tutor load evenly among the population) out of the allocation algorithm did not lead to an extensive overload of individual tutors (De Bakker et al., in press), we decided to keep them in the first prototype since no empirical data on this issue were available.

Although it would be more efficient and user-friendly if such a system would be built as an add-on to existing instant messaging systems such as Skype or Windows Live Messenger (De Bakker et al., 2008), practical considerations forced us to build a stand-alone system for this experiment. Only this way we had full control of all data in the system, such as the chat logs. To allow users to familiarise themselves with the system quickly, its user interface had an appearance similar to that of existing systems (see figure 6.2). The architecture of the system has the form of a client-server model based on TCP connection. The prototype was developed in Borland Delphi 7, supplemented with some existing closed source and open source components. The prototype SAPS system offered online chat primarily, but in addition it also offered off-line chat (in which case the messaging takes place asynchronously, via the same interface though) for those cases in which no peer candidate would be online at the time of the request by the tutee. The students had to install the software client on their computers themselves.

Figure 6.2: *The SAPS client window.*

To verify the quality and effectiveness of synchronous online peer support, we made the SAPS system available to students during a course over a period of three months. If the students had questions on the material while studying at home, they were requested to ask them via the SAPS interface. The application then found the most appropriate fellow student to act as peer tutor for answering the question. In order to be able to compare peer support to teacher support, we chose for an experimental design in which students were assigned to an experimental and a control group at random. Students in

the experimental group had their questions forwarded to the most competent peer, based on the SAPS algorithm. The questions from the control group were all forwarded to one of the course teachers. None of the participants in the control group knew their answers were forwarded to a teacher, they were told that their questions were being answered by peers. In both groups students used SAPS for asking questions. It is important to note here that the ample availability of teachers in this study is atypical. Peer support and teacher support were made available to students to equal extents so as to be able to compare the two, while in an 'ordinary' educational setting teachers are not to be expected to be available all the time. This should be borne in mind while reviewing the results.
In both groups we examined answer quality, test results and student satisfaction. Because the amount of chat data did not meet the expectations (56 logged sessions), an extra session was organised in the PC class at University, prior to the second multiple-choice exam. In this session, students could ask each other questions via SAPS, which was installed on all computers in the room. Contrary to the experimental setup used during the course period, during the session all students' questions were forwarded to fellow-students through the SAPS algorithm for peer allocation.

All participants (*n*=49) were students in the age of 20-28, both males and females, studying an Educational Research Master at a Flemish University, doing a course on Educational Technology. The teacher involved in the experiment was the professor giving the course. To allow the students to get used to the peer support system, the first week of the course was used as an introduction period. During that phase the research team introduced the system, helped the students to install the application on their computers, and explained the procedures of the experiment.

Answer quality was determined by experts' ratings of chat transcripts gathered during the course period. Two external experts, both PhD students in the field of educational technology, rated the answers given by peers selected via the SAPS algorithm and those given by teachers. They were asked to rate to what extent the answers were helpful to the student who asked a question. The ratings were given in the form of a mark from 1 (not helpful) to 5 (very helpful). To determine consistency among raters an interrater reliability analysis was performed by means of determining a Spearman's rho correlation coefficient. This was found to be acceptable (Spearman's rho=0.67, $P<0.001$). In order to determine what the answer quality was as perceived by the tutees themselves, after each chat conversation they were asked to give a rating for the answer similar to that given by experts (i.e. on a 5 point Likert scale). Finally, in a questionnaire distributed at the end of the experiment, students were asked to give their general rating of the quality of peers' answers. They were asked to rate the general quality and reliability of the answers received, as well as the knowledge of tutors, all on a 5 point Likert scale. When they answered these questions, students still thought only peers had supported them.

Learning outcomes were measured by comparing test performance of the peer-supported group to the teacher-supported group. Students in both groups were subjected to a multiple-choice test on the course content, developed by a team of three experts. To distribute the study load of the students evenly over the course period, the test was distributed in two parts. The first test administered halfway through the course period dealt with the first four chapters of the course, the second test was administered at the end of the course period and dealt with the last four chapters. Each test consisted of 40 items (10 for each chapter) with four alternatives. In the analyses, the two tests were combined into one test of 80 items[6]. A Cronbach's Alpha was performed on the total test's results to test its reliability, which turned out to be acceptable (α= 0.69). The two groups were similar in group size, number of support activities and types of questions being asked, but students differed in their prior knowledge. Prior knowledge was therefore used as a covariate in the analyses. To check what the influence of students' prior knowledge of the domain was on the outcomes, we asked some survey questions on knowledge on and experience with educational technology prior to the start of the experiment.

Students' preference for a teacher or peer tutoring respectively, measured in preference for help from teachers or peers on course content support and task support, was measured via a questionnaire distributed prior to the experiment.

After the experiment, all participants were asked to fill in an additional online questionnaire on the usefulness and usability of the SAPS system. The questions asked involved aspects such as the technology used, students' appreciation of online peer support, and the speed at which students received their answers. For data triangulation on the aspect of answer quality,

[6] A significant correlation found between the results of the first and second test (Spearman's rho=0.40, P<0.001) allowed the research team to combine the two tests in the analyses.

the students were asked to indicate the general quality of the answers received via the SAPS system.

6.4 Results

After an initial problematic phase of the experiment, in which the SAPS system was not available to the participating students for two weeks due to technical issues, the students were able to work with the peer support system during the larger part of the course.

Via the questionnaire distributed after the course period usage frequency was measured. Table 6.1 shows students' usage frequencies of the SAPS system during the course period, as indicated by the students themselves.

Table 6.1: *Usage frequencies of SAPS.*

	number of students
None	0
less than 3 minutes a week	3
3 - 10 minutes a week	18
11 - 20 minutes a week	20
more than 20 minutes a week	5
Total	**46**

Nearly all students (45 out of 46) indicate to have asked one or more questions via the system.

6.4.1 Answer quality according to experts' ratings

56 chat conversation transcripts were collected (26 in the experimental group and 30 in the control group)[7]. Two experts rated each transcript on a five-point scale with respect to the quality of answers given by peers. Figure 6.3 shows the distribution of the mean of the pooled ratings of both raters in both conditions in percentages.

[7] An example of a conversation transcript can be found in Appendix 2.

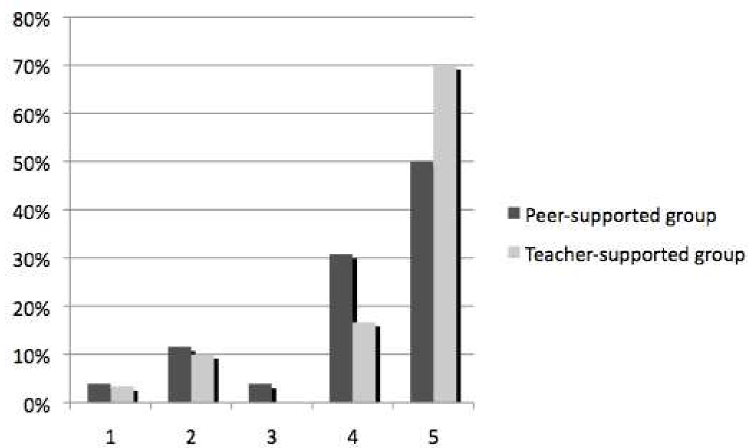

Figure 6.3: *Answer quality in terms of the distribution of the mean of the combined ratings of both raters in the experimental and the control group in percentages.*

In both conditions, the majority of the answers were rated with a 4 or 5 by both raters. When combining the ratings of both experts into one mean rating per answer, a t-test conducted showed no significant difference in rating means between the two groups ($t = -0.92$; $df = 54$; $p = 0.36$).

Following Van Rosmalen et al. (2008), we then isolated questions whose answers are rated with a 4 or 5 by both raters and marked them 'solved', assuming that answers with such ratings are sufficiently helpful to the tutee. When following this procedure, in the experimental group (peers) 16 out of 26 questions were solved (which would be equal to 62%) and in the control group (teachers) 25 out of 30 questions were solved (which would be equal to 83%). There is a large overlap in the confidence intervals of the two groups, as can be seen in Table 6.2, indicating the scores for both groups do not differ much.

Table 6.2: *Confidence intervals of solved questions according to experts' ratings.*

	Mean	0.62	0.83
95% Confidence Interval for Mean	Lower Bound	0.41	0.69
	Upper Bound	0.82	0.97

6.4.2 Answer quality according to students' ratings

65 answer ratings provided by students were collected. This figure differs from the total number of transcripts, since some transcripts were not logged correctly and therefore incomplete. All students' ratings could successfully be retrieved resulting in a higher number of collected ratings. Figure 6.4 shows the rating distribution in the peer group (n = 30) and teacher group (n = 35) in percentages. A t-test conducted showed no significant difference in ratings between the two groups (t = -0.68; df = 63; p = 0.21).

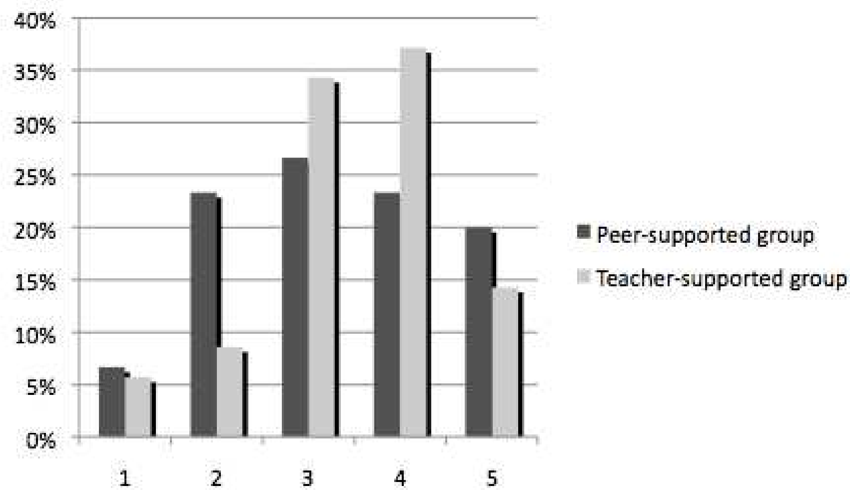

Figure 6.4: *Answer quality in terms of students' rating distributions in the experimental and the control group in percentages.*

Then following again the procedure used for the experts' ratings, we isolated questions of which the answers received a rating of 4 or 5 by the student asking a question and marked them 'solved'. Students are not very positive about the answers received. In the experimental group (peers) 13 out of 30 questions were solved (43%), in the control group (teachers) 18 out of 35 questions were solved (51%). There is a large overlap in the confidence intervals of the two groups, as can be seen in Table 6.3, indicating the scores for both groups do not differ much. The results furthermore show that students give peers' answers a low rating more often than teacher's answers (answers with a rating of 1 or 2), but at the same time peers in a larger number of cases receive the highest rating of 5.

Table 6.3: *Confidence intervals of solved questions according to students' ratings.*

	Mean	0.43	0.51
95% Confidence Interval for Mean	Lower Bound	0.25	0.34
	Upper Bound	0.62	0.69

After the experiment, via the questionnaire students were asked to give a general rating of the quality and reliability of all answers received during the experiments as well as the tutors' knowledge. Their ratings students do not differ significantly (see Table 6.4).

Table 6.4: *Students' general judgments of peer quality*

	General quality of answers	**General reliability of answers**	**Knowledge of tutor**
Teacher group	3	2.9	3.5
Peer group	3.3	3.1	3.6

6.4.3 Extra session

The extra session in the PC class at University resulted in an additional 49 chat conversations. The same experts rated all 49 conversations on a 5 point Likert scale. However, the interrater reliability for the extra session was low (Spearman's rho=0.40, p<0.001). Students' ratings on a 5 point Likert scale were available for 43 of the 49 conversations. Figure 6.5 shows the rating distribution in percentages.

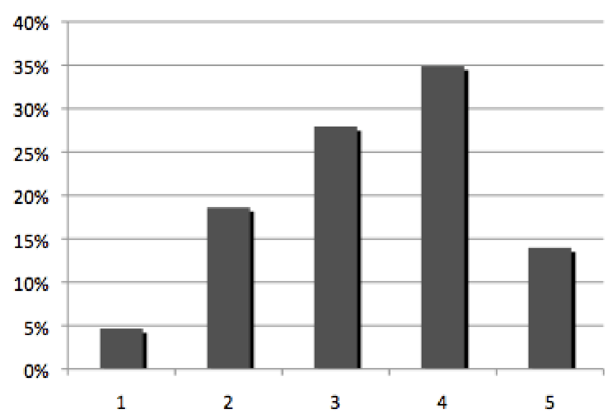

Figure 6.5: *Students' rating distributions in percentages.*

Students are neutral to slightly positive in their judgment of the answers given. Following the procedure for solved questions, according to the students themselves 21 of the 43 questions were solved during the session (49%).

6.4.4 Test performance of students supported by peers versus students supported by teachers

44 participants completed both multiple-choice tests on the first and second part of the course, 21 students in the experimental group and 23 in the control group. Table 6.5 shows the mean score (items correct) and the standard deviations of the students on both 40-items tests and the standard deviations.

Table 6.5: *Mean test scores (items correct) and standard deviations in both groups.*

Condition	*N*	*Mean score on test (standard deviation)*
Experimental group: peer-supported students	21	50.48 (8.08)
Control group: teacher-supported students	23	49.87 (4.83)

An ANCOVA performed on the test results of both groups showed no significant difference between the peer-supported and teacher-supported group and no effect of prior knowledge, as can be seen in Table 6.6.

Table 6.6: *ANCOVA results of both groups' multiple choice test results show no significant difference between groups and no effect of prior knowledge.*

Tests of Between-Subjects Effects

Dependent Variable:Nr_correct

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	53.513[a]	2	26.757	.620	.543	.029
Intercept	10710.436	1	10710.436	248.043	.000	.858
PriorKnowledge	49.474	1	49.474	1.146	.291	.027
Group	3.777	1	3.777	.087	.769	.002
Error	1770.373	41	43.180			
Total	112525.000	44				
Corrected Total	1823.886	43				

a. R Squared = .029 (Adjusted R Squared = -.018)

Figure 6.6 shows the confidence intervals for both groups' test results. Although the distributions of both groups are not symmetrical and there is a difference in the means of both groups, there is a large overlap in the confidence intervals of groups.

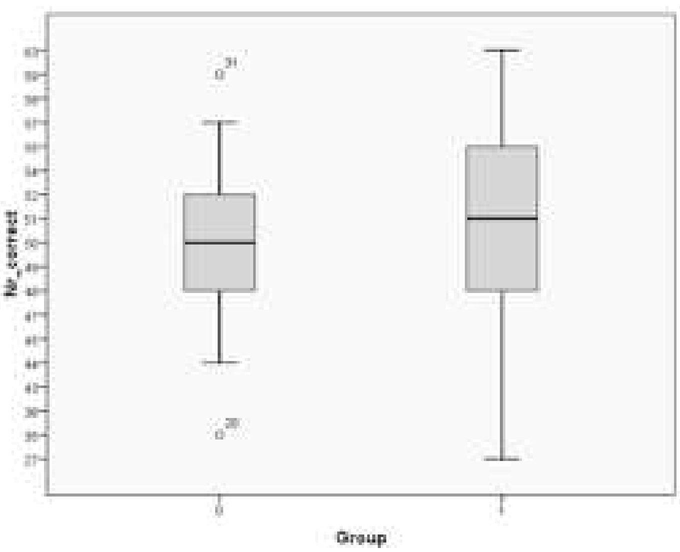

Figure 6.6: *Confidence intervals of both groups' multiple choice test results show an overlap between the two groups.*

6.4.5 Students' support preference

48 Students completed a questionnaire administered at the beginning of the course. They were asked to indicate both their general expected need for help on course content from teachers and the need for help from fellow-students on a 6-point scale. The participants preferred the help on course content from fellow-students to that of teachers (figure 6.7).

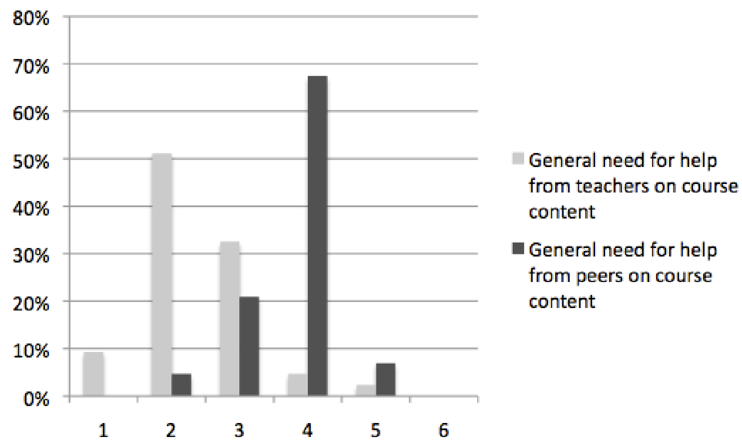

Figure 6.7: *Distributions of the general need for help on course content as indicated by students.*

Figure 6.8 shows students also preferred help on tasks from fellow-students over teachers.

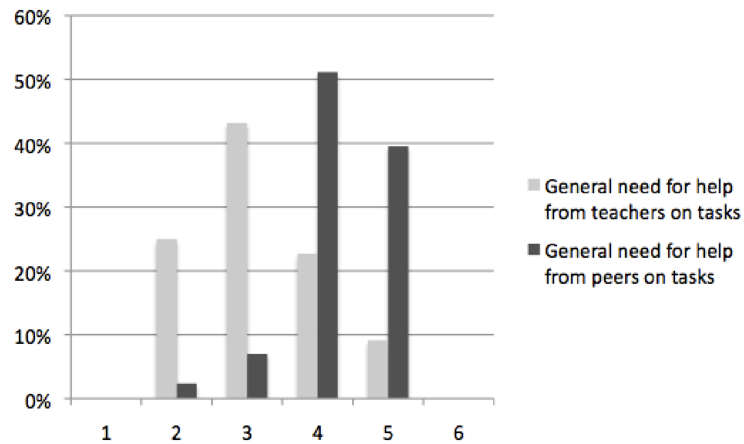

Figure 6.8: *Distributions of the general need for help on tasks as indicated by students.*

Figure 6.9 shows that students indicated they generally ask more questions to fellow-students than they do to teachers. The results are in line with the general need for help from peers and teachers respectively.

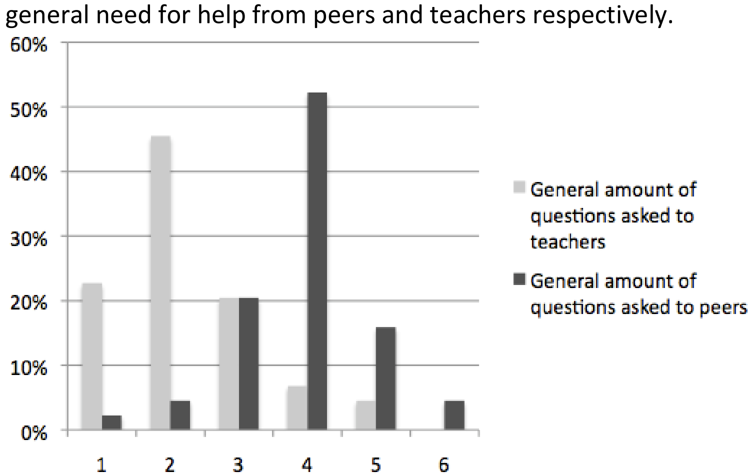

Figure 6.9: *Distributions of the general amount of questions as indicated by students.*

6.4.6 Students' appreciation of (a system for) online synchronous reciprocal peer support

The results of the questionnaire the participating students completed at the end of the course shed light on their attitude towards peer support, the technologies used and SAPS specifically.

29 of the 46 participants appreciate in general being tutored by fellow-students instead of teachers, 15 participants have a neutral judgment, and 2 are negative about being tutored by fellow-students instead of teachers. Half of all students think their fellow-students' are willing to help. When the participants were asked to indicate whether they were willing to act as peer tutor, 37 of them answer positively. Most common reasons put forward by the students are that 1) it is nice being able to help someone else, 2) you learn yourself by tutoring others, and 3) if you want to be helped you have to help others as well. 35 of the 46 students think the time spent on answering questions is well-spent, because it gives them a good feeling being able to help, it shows them that other students also have questions, and it improves their own learning.

27 participants appreciate working with an online system for their support questions. When asked about their opinion on instant messaging, the majority (25 students) appreciate working with the technology for asking questions, and 33 students like using it in general.

29 of the 46 students see much added value in an online peer support system like SAPS, and half of the students would like to use SAPS in other courses. Considering the technical difficulties encountered at the beginning of the experiment this percentage is rather high. Other students prefer different technologies such as discussion boards, or asking teachers or students face-to-face.

SAPS notified its users of the number of active SAPS users currently online. 29 students found these messages helpful, 11 did not find them helpful and 6 had not seen them or did not have an opinion. Students specifically appreciate that the notice provides an indication of the number of people available to help, and that it shows them there are other people studying at the moment.

6.5 Conclusions and discussion

This chapter reported on a field experiment conducted with the SAPS system to test its effectiveness in terms of peer answer quality, test performance of students being supported by peers, and students' appreciation of online peer support and their general support preference. As stated previously, in order to be able to compare peer support to teacher support, we chose an experimental design through which we made teacher support available to students to a far greater extent than usual. The course teachers were available daily via the SAPS application to answer students' questions almost immediately. Obviously this is an artefact of the study as it aggravates rather than solves one of the that inspired the development of the SAPS system, to wit, the high tutoring load that teachers face. It is because of this problem that we proposed to investigate the effectiveness of peer support as a first alternative for teacher support. The results found will be discussed based on this context.

6.5.1 Answer quality

In this study we compared the quality of answers given by peers to those of teachers in an online support context. When comparing the ratings of both groups' sessions, the difference turns out to be not significant. This is the case for the experts' ratings as well as the ratings the tutees gave themselves. These findings are in line with students' general ratings of the quality and reliability of the answers received and the knowledge of the tutors they had been in contact with, which were similar for tutees from both groups.

When following the procedure of marking answers with ratings of 4 or 5 as solved, we see a somewhat different picture. The hypothesis that students would rate the majority of peers' answers positively has to be rejected, since only 43% of the answers were marked as solved. However, at the same time the data showed that students are not particularly positive about the answers received by teachers either; 51% were marked as solved. Students were slightly more positive in their rating of the answers received during the extra session in PC class. Experts generally rated the answers given in both conditions higher than did the students. Although teachers are able to answer more questions sufficiently well (82%) than peers, peers are still able to do so in the majority of cases (63%). The results found during the extra session are in line with these findings, although the reliability found during this part of the study turned out to be low.

So as expected, both the experts' and the students' ratings showed that more teachers' answers than peers' answers could be marked as solved. At the same time the findings indicate that, while 63% of students' questions were sufficiently answered by students, peer support systems could be a proper alternative for some of the tutoring currently done by teachers. The answer quality issue should however stay in focus. Van Rosmalen et al. (2008) found that with their peer allocation system 75% of students' questions were solved, so adding an asynchronous component, selecting more peers per request or helping tutors by providing them with additional information for answering specific questions, could further enhance the quality of the SAPS system. That would however be in contrast with the current lightweight character of the system (i.e. only few assumptions on the learning content and participating students are needed), which makes implementation less time- and resource-consuming.

6.5.2 Test performance

The ANCOVA showed that the mean number of correct answers on both tests did not differ significantly between the experimental and the control group. Also, taking into account prior knowledge did not result in different findings. It can therefore be concluded that the performance on multiple-choice tests of students supported by peers does not differ from the performance of students supported by teachers.

6.5.3 Students' appreciation and support preference

The questionnaire on support preference showed the opposite of what we expected. While two of the three studies mentioned earlier found that students actually prefer the expertise of teachers (Hart, 1990; Schmidt et al., 1994), students in our study indicate they generally have a bigger need for help from peers than from teachers. Accordingly, they generally ask more questions to peers than they do to teachers. It should be specifically noted here that these results were found prior to the experiment, so their opinion was not influenced by their experiences during the experiment. The questionnaire did not ask the students for the reasons for their preference. Additional research could show whether these findings are purely caused by students' preference, or whether they are possibly coloured by other factors, such as their expectations of the availability of teachers or a fear of making a bad impression on the teacher.

The questionnaire on user appreciation shows that the majority of students are generally satisfied with being supported by peers via an online peer support system, in line with the findings on the general need for help from peers and teachers, which showed a slight preference for peer support. Most findings were however only moderately positive. Additional research should show whether these findings were caused by a negative appreciation of the concept of online peer support systems in general, or whether the outcomes were negatively influenced by the technical difficulties students encountered while working with the SAPS system in the beginning of the experiment.

In conclusion, online reciprocal peer support using instant messaging with the SAPS allocation algorithm is a proper alternative for teacher support on questions, when teacher support is not available. Even in contexts were teachers are available, it could be efficient to have peers answer questions first, as they are able to answer the majority of fellow-students' questions, thus decreasing the teachers' tutoring load. Furthermore, the results of this study indicate that peer-supported students do not perform worse than teacher-supported students on multiple-choice tests. Perhaps as important as these findings is the positive attitude the majority of the participating students have towards an online reciprocal peer support system using instant messaging.

6.6 Acknowledgements

We would like to thank Sybilla Poortman and Paul Dirckx of the Fontys University of Applied Sciences for their help on developing materials for the experiments' course, and Amy Hsiao, Sibren Fetter and Rory Sie who where the expert raters for this study.

CHAPTER 7

The quality of online reciprocal peer support in a distance education context without teacher availability

Abstract

Over the last decades, student populations in higher education have become less homogeneous and learning has become more self-regulated. Some attempts have been made to introduce online peer support to decrease the tutor load of teachers. As a contribution to this field we proposed a system that facilitates synchronous online reciprocal peer support activities for ad hoc student questions: the Synchronous Allocated Peer Support (SAPS) system. Via this system, students with questions during their learning are allocated to competent fellow-students for answering, using an instant messaging (IM) tool for communication. In a previous empirical study we found that via the SAPS system, peers were able to answer the majority of fellow-students' questions sufficiently, which makes peer support via the system a proper first alternative to teacher support when that is unavailable. The results were found in a context in which students had face-to-face contact with each other as well as teacher contact via lectures at a residential university. In order to investigate whether peers' answer quality is similar in a setting lacking face-to-face contact with fellow-students or teachers, further research was needed. This chapter reports on a field experiment conducted with the SAPS system. We empirically tested results previously found from a simulation study on the SAPS system's effectiveness in terms of peer answer quality and willingness of peers to answer fellow-students' questions. Furthermore, the study focused on students' appreciation of online peer support and their general support preference. The study shows that peers are able to answer the majority of fellow-students' questions sufficiently well. The percentage of questions remaining unanswered, used as an indication for students' willingness to act as peer tutor, was fairly high, but remained constant over time. The majority of students perceived a system for online reciprocal peer support as useful and usable, although their specific appreciation of IM for such purposes was less positive.

7.1 Introduction

(Higher) education has changed under the influence of changes in society over the last period (Westera & Sloep, 2001). The popularity of the internet for example has resulted in increase in learning independent of place and time. This makes student populations more heterogeneous, as students are not all studying at the same time. Besides, as self-regulation is gaining popularity in higher education, teachers are faced with growing support needs of students. This has increased their workload (Fox & MacKeogh, 2003). For example, where teachers previously could answer similar students' questions at once during e.g. a lecture, they are now faced with the same questions being asked several times via e-mail. This growth is even reinforced by younger students expecting other people to use modern communication tools in a similar way as they do themselves (Prensky, 2001; Simons, 2006): students use ICT regularly and expect their teachers to do the same. Teachers indicate the answering of student questions is time-consuming (De Vries et al, 2005). Several attempts have been made to provide a solution to this problem by introducing online peer support. Many (higher education) institutes have introduced some form of peer support, mostly via online discussion boards such as in the BlackBoard VLE. Possible drawbacks of such boards are that it can be unclear whether the peer who answers a question is actually fit for the job; there might be more competent peers in relation to the specific question. Also, discussion boards are always asynchronous. This means there is a higher chance that questions remain unanswered. If no one feels responsible to answer a question since no one has been appointed to answer, it is hard to be sure if and when a question will be answered.

To ensure the quality of peers' answers, online peer support systems are being developed that use an allocation mechanism that aims to select more competent peer tutors (e.g. Van Rosmalen et al., 2006; Sloep et al., 2007). Such systems route students' questions to fellow-students that are selected on their competence to answer specific questions (Westera, De Bakker & Wagemans, 2009; Van Rosmalen et al., 2008). Elsewhere we introduced a system that facilitates reciprocal peer support activities via instant messaging: the Synchronous Allocated Peer Support (SAPS) system (De Bakker et al., in press). It is based on the assumption that cohorts of students work on modular (i.e. chapters, topics, etc.) learning materials. Via this system, students with questions during their learning are allocated to competent fellow-students for answering. The SAPS system is designed for reciprocal peer support activities among a group of students who work on the same modular material every student has to finish, such as courses with separate chapters. Furthermore, it distinguishes itself from similar initiatives by the allocation mechanism being suitable for smaller student populations and the use of instant messaging (IM) as the main technology. Instant messaging was used since most students are already familiar with this medium in the context of helping each other on study tasks (De Bakker, Sloep & Jochems, 2007).

For each specific question a student (tutee) has, a computer algorithm selects the most competent fellow student available in the peer group to act as peer tutor, based on the following criteria/parameters:

- Quality - proximity: looks for peer candidates currently working on or having recently completed the same modular learning material as the tutee.
- Quality – question type: looks for peer candidates who have indicated to be competent in the question type asked for by the tutee. What these questions types are depends on the context in which the system is applied, but examples would be ‘theoretical questions’ or ‘technical support questions’.
- Quality – previous result: looks for peer candidates who have acquired high marks on e.g. courses with similar topics.
- Economy – favour-in-return: prioritises those students who have already asked many questions themselves.
- Economy – uniformity: prioritises those students who have previously had few tutor turns. Economy principles are useful to prevent overload of individual peer tutors by spreading the tutor load evenly among the population.

Figure 7.1 shows the SAPS allocation algorithm displaying the activity sequence from question to peer-support chat session, as well as the allocation procedure and criteria used for matching students for the peer support activities.

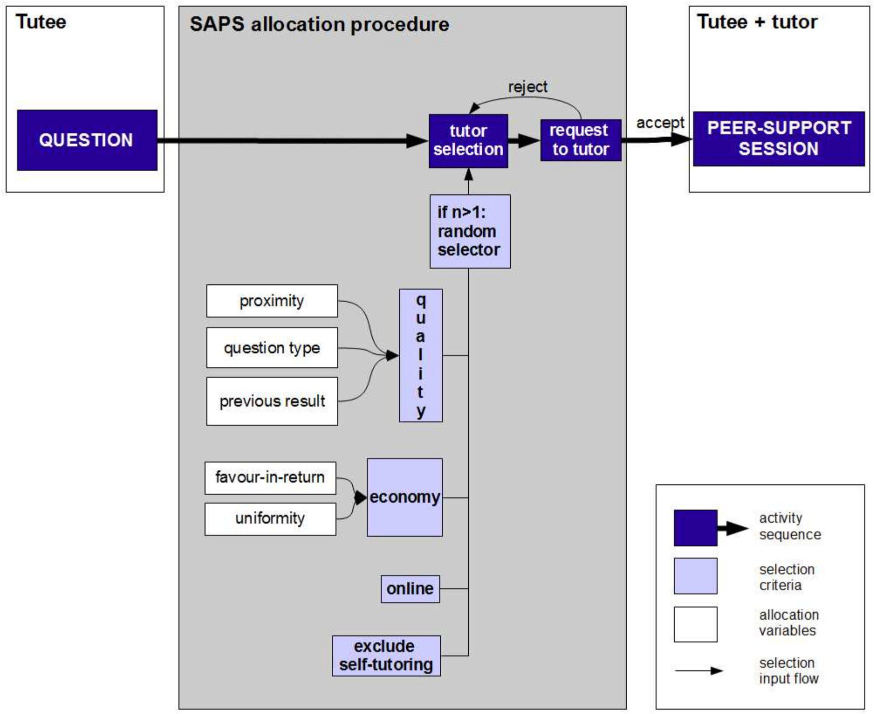

Figure 7.1: *The SAPS algorithm.*

7.2 Research questions

Previously we conducted a study on a simulation of a SAPS-based allocation mechanism in a software simulation environment, which focused on peer competence and sustainability, the second requirement for an online reciprocal peer support system mentioned in Chapter 2 (De Bakker et al., in press). The simulation intended to indicate whether the SAPS allocation algorithm was able to select sufficiently competent peer tutors to answer fellow-students' questions. Furthermore, it examined whether an online reciprocal peer support system based on the SAPS system was sustainable over a longer usage period, i.e. if students remained willing to act as peer tutor. Analyses of the simulation runs indicated that the system was able to select sufficiently competent peers and that, under the model assumptions, students remained willing to act as peer tutor over a longer time period. Simulation was chosen as a method in this study since simulations offer an opportunity to clarify causal relationships and interdependencies in a much more flexible manner than possible when using empirical testing (Gilbert & Troitzsch, 2005). An important drawback of using simulations however is that "in a simulation one is experimenting with a model rather than the phenomenon itself" (Gilbert & Troitzsch, 2005, p. 14). A simulation model is always based on several assumptions about the target (i.e. the system or phenomenon at study). Although these assumptions are largely based on empirical knowledge of that same target, a simulation model is always less complex than in the target itself, thus leaving room for unintended and unexpected model behaviour (Gilbert & Troitzsch, 2005). This emphasizes the need for empirical testing of the same topics the simulation was focused on, to check whether the simulation results hold in practice.

As stated previously, in the simulation study among other outcomes it was found that:

a) the SAPS system was able to provide sufficiently competent peer tutors
b) the SAPS system would be sustainable (i.e. students remained willing to act as peer tutor) over a longer usage period

Regarding a), in a previous empirical study (De Bakker et al., 2010a) it was found that indeed a SAPS-based online peer support system was able to provide competent peer tutors. 63% Of peers' answers given to fellow-students' questions could be marked as solved according to experts' ratings of the answers, which indicates that the SAPS system offers sufficiently competent peer tutors for support requests. The results were however found in the context of face-to-face education, in which students had contact with teachers and fellow-students weekly. This might have influenced the results of the study, since for example some of the students' questions might have been asked during the teachers' lectures. It is valuable to examine whether the SAPS system provides sufficiently competent peer tutors, i.e. tutors who are able to answer a sufficient number of fellow-students' questions sufficiently well, in contexts in which teacher support is unavailable. Results with a similar online peer support system based on allocation of competent peer tutors have shown promising results. Van Rosmalen et al. (2008) carried out an empirical study in the context of an online course in which teacher support was not available and found that the majority of peers were able to answer fellow-students' questions.

Regarding b), our previous empirical study on the SAPS system (De Bakker et al., 2010a) did not focus on students' willingness to answer fellow-students' questions, since the outcomes found would have been influenced by contextual factors too much. The most important factor is that students were asked to actively participate in the experiment by the teachers of the course. It could therefore be questioned whether their willingness to answer fellow-students' questions was intrinsic. Van Rosmalen et al. (2008) examined students' willingness to answer fellow-students' questions in a setting in which students were not actively stimulated to act as peer tutor (other than the direct invitation to answer a question), by looking at the percentage of questions eventually being answered by peers. They found that students were willing to help others, as only 9% of the questions remained unanswered. However, their experiment lasted for only eight weeks. In our simulation study we found similar results on the sustainability issue: only 10% of the questions asked by tutees remained unanswered. Based on the above results we believe similar results would be found when the SAPS system is applied in a setting in which no teachers are available. A second important aspect in the willingness of peers is whether they remain willing over a longer time period. Van Rosmalen et al. (2008) did not examine this aspect, but our simulation study indicated students indeed remained willing over time. This will be tested empirically in the present study.

An important factor in the acceptance of a new approach to student support, such as our online reciprocal peer support system, is students' appreciation. Our first empirical study on the SAPS system (De Bakker et al., 2010a) examined how students appreciate an online reciprocal peer support system. The majority of the students appreciated such a system as useful, in line with results found earlier in which an allocation algorithm similar to SAPS was used (Westera et al., 2009). In all of these contexts however, a teacher was present. Van Rosmalen et al. (2008) examined students' appreciation of an online reciprocal peer support system in a setting in which no teachers were available. They found that students were generally satisfied with the support system as the majority perceived it as useful and usable. It is expected the same results would be found when our SAPS system is implemented in a setting where no teacher is present.

Taking the above considerations into account, we decided to test the following hypotheses:

- At least 50% of the answers given by peer tutors selected via the SAPS algorithm in a setting in which teacher support is unavailable are rated positively by experts. In our view the investments needed to implement a peer support system in a given situation would be justified if peers are able to answer half of the students' questions.

- At least 50% of the answers given by peer tutors selected via the SAPS algorithm in a setting in which teacher support is unavailable are rated positively by students. In our view the investments needed to implement a peer support system in a given situation would be justified if peers are able to answer half of the students' questions.
- Students remain sufficiently willing to answer each other's questions over a period of several months in a setting in which teacher support is unavailable. Sufficiently willing is defined here as 90% of the question invitations of the system is being accepted by the selected peers, and that the number of rejections and ignored requests does not increase over time.
- Students perceive (a system for) online synchronous reciprocal peer support as being useful and usable when that is the only support available.

7.3 Method

For the purpose of this experiment a software application of the SAPS online peer support system was developed, based on the SAPS allocation algorithm (De Bakker et al., in press). After some technical issues experienced with a previous prototype (De Bakker et al., 2010a) of the SAPS system, we decided to build a new system for this experiment from scratch, called the *WhoKnows?* application. As the previous prototype, the new software was stand-alone to give us full control of all data in the system, such as the chat logs. The user interface resembles those of existing IM systems. The architecture of the system has the form of a client-server model using soap services for communication. The application was developed in Borland Delphi 2009 and made use of existing closed source and open source components. It offered online chat primarily, but also allowed off-line chat for those cases in which no peer candidate would be online at the time of the request by the question asking student (tutee). Figure 7.2 shows the *WhoKnows?* application's screen for asking questions in which users can type their question, select the course module the question is about (the software automatically suggests the module they are currently working on) and a question type. Once filled in, they can submit their question via the menu on the right.

Figure 7.2: *The WhoKnows? client question window.*

We made the *WhoKnows?* application available to participants in a free online course on internet skills, delivered via a VLE. The course consisted of ten course modules on topics such as web search and web 2.0. The course had an estimated total study time of 24 hours. The participants could complete the modules at their own study pace during the four month period the course was available online. Each module was completed via a short multiple choice test, which was used to automatically track their progress. This was done to determine 'proximity' in the SAPS allocation algorithm. If the course participants had questions on the material while studying at home, they were requested to ask them via the *WhoKnows?* client which they could install on their personal computers. This application communicated with the SAPS server for finding the most appropriate fellow student to act as peer tutor for answering the question. All participants' questions were forwarded to fellow-course participants based on the SAPS algorithm for peer allocation.

The course was advertised via the website of the Open University of the Netherlands. Therefore, it mainly attracted the Open University's distance-learning students. Initially 736 participants, both males and females, signed up for the course. 413 of them eventually started on the course and 281 participants finished all course modules before the deadline. Although this is a high dropout rate, it is quite common in the context of distance education. Figure 7.3 shows the age distribution of the 288 course participants who completed a questionnaire after the course; the questionnaire asked for the students' age among other aspects. The figure shows that the majority of the participants were aged 41-70.

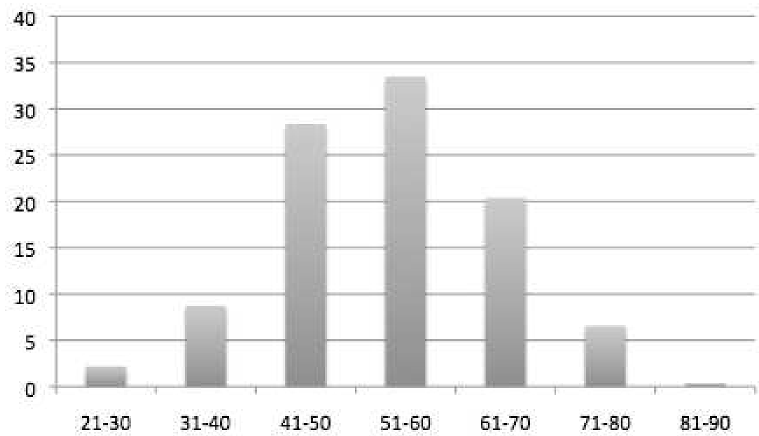

Figure 7.3: *Number of course participants in each age category in percentages.*

During the entire course no teacher was available. All questions asked by students were submitted via the application and forwarded to a peer tutor.

Answer quality was determined by experts' ratings of the chat transcripts that had been gathered during the course period. Two external experts, both PhD students in the field of educational technology, rated the answers given by the peer tutors. They were asked to rate to what extent they felt the answers were helpful to the student who asked a question. The ratings were given in the form of a mark from 1 (not helpful) to 5 (very helpful). To determine consistency among raters an interrater reliability analysis was performed, by means of determining a Spearman's rho correlation coefficient. It was found to be acceptable (Spearman's rho=0.69, $P<0.001$). In order to determine how the tutees themselves perceived answer quality, they were asked to give a rating for each answer received via the system, in the form of a mark from 1 (not helpful) to 5 (very helpful).

Students' willingness to answer each other's questions was measured via an analysis of the logging data. It was analysed how many questions were asked overall and how many questions remained unanswered. It was furthermore analysed whether the percentage of unanswered questions remained constant over time.

In order to measure students' appreciation of online reciprocal peer support, after the experiment all participants were asked to fill in an additional online questionnaire on the usefulness and usability of the *WhoKnows?* application. 288 Participants (70%) responded to our request. The questions asked involved aspects such as the technology used, using peers for support activities, and the speed at which students received their answers. For data triangulation on the aspect of answer quality, the students were asked to indicate the general quality of the answers received via *WhoKnows?*.

7.4 Results

In total, 140 questions were asked via the *WhoKnows?* application by 82 course participants. 99 Questions were eventually answered.

7.4.1 Answer quality according to experts' ratings

Each of the 99 chat transcripts was rated by the two experts. Figure 7.4 shows the distribution of the mean of the pooled ratings of both raters in percentages.

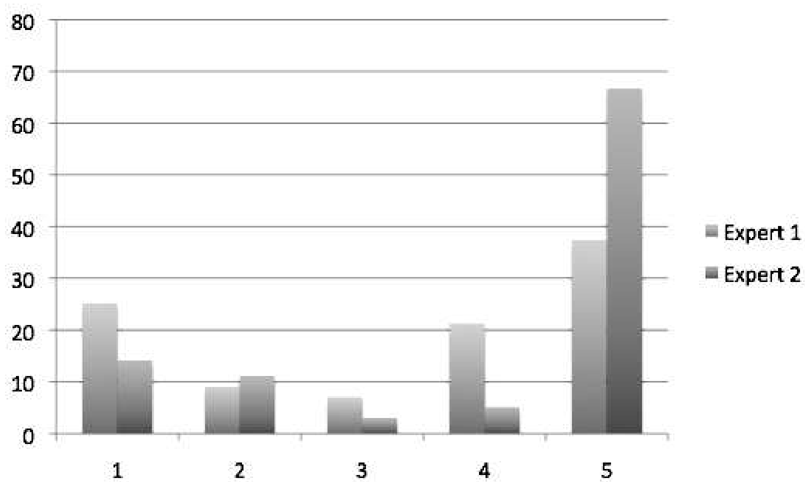

Figure 7.4: *Answer quality in terms of the distribution of ratings of both raters.*

Following Van Rosmalen et al. (2008), we marked questions whose answers are rated with a 4 or 5 'solved'. When following this procedure, 57 out of the 99 questions were solved (57%).

7.4.2 Answer quality according to students' ratings

93 answer ratings were collected. This figure is lower than the number of transcripts, since some tutees did not provide a rating for every answer they received. Figure 7.5 shows the rating distribution of the collected ratings.

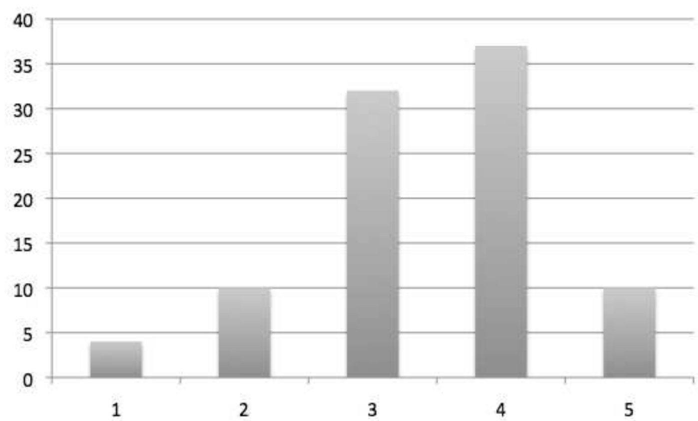

Figure 7.5: *Answer quality in terms of students' rating distributions.*

Following the procedure used for the experts' ratings, we marked questions of which the answers received a rating of 4 or 5 by the student asking a question as being solved. 47 out of 93 questions were solved (51%).

7.4.3 Willingness of peers

As stated previously, during the experiment 140 questions were asked, of which 99 were eventually answered (71%), 19% less than the 90% hypothesised. However, the 29% unanswered questions covers several situations. 38% Of the unanswered questions refer to situations in which the tutor accepted a tutee's request and a chat session was initiated, but eventually no communication took place between tutee and tutor. 5% Was due to tutees cancelling their request before a tutor had a chance to respond. The remaining 57% of the unanswered questions was cause by either the request being ignored or not seen by the tutor or being actively rejected.

Figure 7.6 shows the occurrences of the situations leading to questions remaining unanswered in percentages.

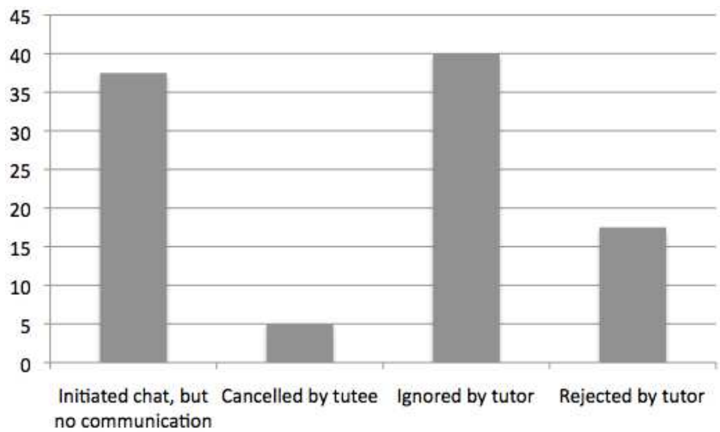

Figure 7.6: *Occurrences of situations leading to unanswered requests in percentages.*

Discounting chats initiated but without communication and requests cancelled by the tutee, 16% of the questions posed remain unanswered.

The percentage of unanswered questions remained constant during the course period. Figure 7.7 shows the number of unanswered requests over time in relation to the number of requests per week. There was no increase in unanswered requests as the course period progressed (r = -.058). The peaks in the number of questions asked are probably caused by the beginning and end of the course period, which are usually times when course participants are more active. Another remarkable aspect is that the 5 questions submitted in the last week all remained unanswered, which might be due to deadline of the course period. Leaving this last week out of the analyses, the 16% of unanswered questions mentioned above would further decrease to 13%.

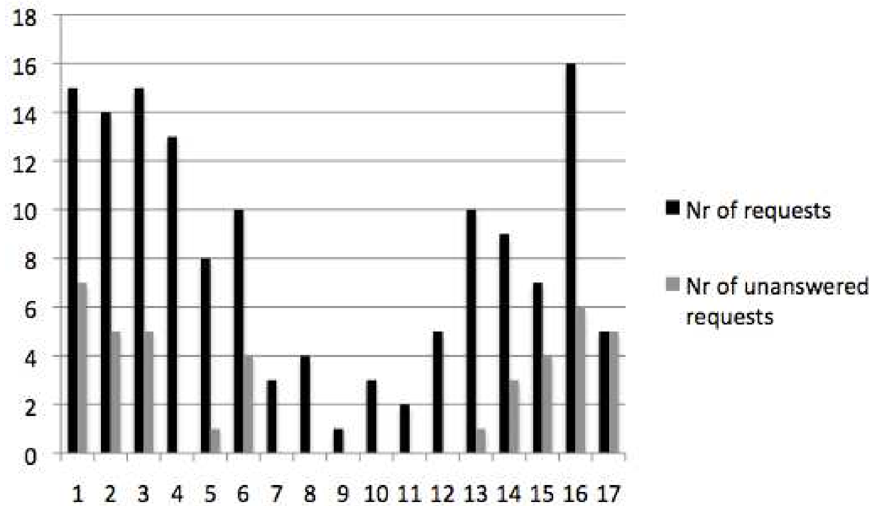

Figure 7.7: *Number of unanswered requests over time in relation to the number of requests per week.*

7.4.4 Students' appreciation of (a system for) online synchronous reciprocal peer support

The 288 questionnaires (70%) of the course participants completed at the end of the course shed light on their attitude towards peer support, the technologies used and the *WhoKnows?* application specifically.

27% of the respondents appreciate in general being tutored by fellow-students instead of teachers, 58% of the respondents have a neutral judgment, and 15% are negative. When the participants were asked to indicate whether they were willing to act as peer tutor, nearly half of the respondents (49%) answer positively. 34% have a neutral judgement and 17% answer negatively. Most common reasons put forward by the respondents for being willing to help are that 1) it is nice being able to help someone else, 2) you learn yourself by tutoring others, and 3) if you want to be helped you have to help others as well. The participants who indicated to not be willing to help their fellow-students had two main reasons for it; they were afraid they would not know the answer, or they had a lack of time. Interestingly, participants did not experience their fellow-students' willingness to help to the same extent. Nearly half (47%) of all respondents think their fellow-students' are not willing to help, 42% are neutral and 11% are positive. 69% of the respondents who acted as peer think the time spent on answering questions is well-spent, because it gives them a good feeling being able to help, it shows them that other students also have questions, and it improves their own learning.

The *WhoKnows?* application showed to its users the number of users currently online. 40% of the respondents found these messages helpful, 8% did not find them helpful and 52% had not seen them or did not have an opinion. Participants specifically appreciate that the notice provides an indication of the number of people available to help, and that it shows them there are other people studying at the moment.

57% of the respondents appreciate working with an online system for their support questions, 31% is neutral and 12% is negative towards it. They were not asked for their reasons. The participants were also asked what they thought of using IM for getting online support. Their opinion on this issue shows a more diverse picture: 36% answer positively, 33% negatively, and 31% is neutral. These findings might be influenced by students' experience with IM: the majority of respondents (63%) have little to no experience with the medium. The logged chat transcripts confirmed students' unfamiliarity with IM. Most chat conversations consisted of one question and one answer message, so hardly any interaction took place between the tutee and tutor about the answer given.

The majority of the respondents are neutral towards or see added value in an online peer support system like *WhoKnows?*, only 20% sees no added value in such a system. 55% of the respondents would like to use *WhoKnows?* in other courses. Other respondents prefer different technologies such as discussion boards, or asking teachers or students face-to-face. They were not asked about the reasons for these preferences.

7.5 Conclusions and discussion

This chapter reported on a field experiment conducted with the *WhoKnows?* application. We tested previously found results from a simulation study on the SAPS system's effectiveness in terms of peer answer quality, willingness of peers to answer fellow-students' questions. Furthermore the study focused on students' appreciation of online peer support.

7.5.1 Answer quality

The study showed that peers are able to answer the majority of fellow-students' questions sufficiently, as according to the students' ratings 51% of the answers could be marked as solved and according to the experts' ratings 57% of the answers could be marked 'solved', percentages which are similar to the percentage found (63%) in a previous empirical study on the SAPS system. These findings indicate the allocation algorithm is able to arrive at sufficiently competent peers in the majority of cases. We therefore conclude that peer support systems could be a proper alternative for some of the tutoring currently done by teachers in settings similar to the one this study was conducted in. Van Rosmalen et al. (2008) found that with their peer allocation system 75% of students' questions were solved. As the differences between their and our system were asynchronous communication, several peers answering a single question, and helping tutors by providing them with additional information for answering specific questions, adding these features to SAPS could possibly further enhance the competence of peers selected by the algorithm. That would however be in contrast with the current lightweight character of the system (i.e. only few assumptions on the learning content and participating students are needed), which makes implementation less time and resource consuming.

7.5.2 Willingness of peers

Since far more than the expected 10% of tutee's questions remained unanswered, our hypothesis on the willingness of peers has to be rejected. However, when the initiated chats without communication and cancelled requests by the tutee are not counted, 16% or even 13% (when the last week is not counted) of the questions submitted remain unanswered, percentages much closer to the hypothesized 10% and previously found results (Van Rosmalen et al., 2008; De Bakker et al., in press). With the currently available data, it is not possible to clarify the reasons for so many initiated questions without any communication being present in the log files. This could be due to students' unfamiliarity with applications such as *WhoKnows?*.

Given the current situation of 30% of the questions remaining unanswered this poses a potential risk for success when implementing online reciprocal peer support. If the percentage would further increase, it is to be expected that tutees are inclined to look for alternatives for finding support. Looking at the sustainability of our system, the results are more promising. The number of unanswered requests remains constant over a usage periods of several months, so it seems students' willingness remains constant over time as well.

7.5.3 Students' appreciation of (a system for) online synchronous reciprocal peer support

The questionnaire on user appreciation shows that the majority of the respondents are generally satisfied with being supported by peers via an online peer support system, but IM is less appreciated for such purposes, which might be due to their unfamiliarity with the medium. This raises an important concern for the SAPS system's potential success. The population of this study that did not grow up with IM (as the majority is aged 41-70) are less keen on using it for support activities than the student population in a previous study (De Bakker et al., 2010a). In that study, the majority of students appreciated using IM for online peer support activities. This difference in appreciation between ages is in line with the differences in IM familiarity and acceptance found in our survey on educational use of IM (De Bakker et al., 2007).

Interestingly, while 30% of the questions remain unanswered, the larger part of the respondents (49%) indicated to be willing to help each other by acting as peer tutor. Apart from the apparent discrepancy with the percentage of unanswered questions, this figure is remarkably high. This may be caused by participants' 'internal self-concept motivation' as described by Yang & Lai (in press). This concept refers to the fact that people gain confidence in their competences by sharing knowledge with others. Yang & Lai found this was the stimulant for people to contribute to Wikipedia, but the same concept may be causing a large number of participants to indicate to be willing to help others. The respondents are negative in their judgement of fellow-students' willingness. This judgment is again in line with the high percentage of questions that remained unanswered during the experiment.

An interesting finding that was not of direct concern to this study, was that out of the 99 conversations that took place, only 9 conversations were synchronous chats. The vast majority of the communication between peers took place via asynchronous use of the messaging tool of the *WhoKnows?* application. The logging indicated this was probably due to the fact that course participants were online in the course at different times, since the mean number of online users during the day was five. It is however unclear whether this means that students study at different times. It could be that they did not use the *WhoKnows?* application all the time they were online in the study environment, since the majority of users indicated to use the application less than 3 minutes a week, not in line with the time they spent on the course itself. Also, feedback given via email to the course team by some course participants indicated that some participants only logged onto *WhoKnows?* when they had a question themselves, after which they logged off again. We believe this behaviour could have been caused by two factors. It could be that it is due to the previously reported unfamiliarity of students with IM, or it could be an indication for students' attitude towards helping each other. Their self-reported willingness to help might have suffered from a social desirability bias, while their actual behaviour could be an indication of not being willing to remain online to be available to help others. Additional research on students' attitude when it comes to helping each other could shed light on this issue. If their unfamiliarity would actually be influencing their use of and behaviour in systems such as SAPS, it could be questioned whether implementing peer support via IM among a population similar in age compared to the population of this study, is advisable. At the same time one could argue that an investment in educating students on the value of new tools is worthwhile.

In conclusion it can be said that online reciprocal peer support using instant messaging with the SAPS allocation algorithm is a proper alternative for teacher support on questions, when teacher support is not available, looking at the quality of the peer support provided. Even in contexts were teachers are available however, it could be cost-efficient to have peers have a first go at answering fellow-students' questions, as they are able to answer the majority of them, thus decreasing the teachers' tutoring load. Important issues when implementing this form of support however are students' willingness to answer fellow-students' questions and the participants' age, as this might be of influence on their attitude towards and their familiarity with an online reciprocal peer support system using instant messaging, which is possibly reflected in the outcomes of the study (e.g. the high percentage of unanswered questions).

7.6 Acknowledgements

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CHAPTER 8

Conclusions and discussion

8.1 Introduction

This dissertation has discussed the feasibility of online peer support systems and focussed on forms of instant messaging (IM) as the means of communication between peers to be used by such systems. The organising principle for it has been an analysis of requirements that any such system should meet in order to be able to lay a claim to success. The analysis is founded on a survey of extant literature, on empirical studies and on a simulation study. Before going into a discussion of this study's main findings, the requirements analysed are summarised and briefly discussed.

1) Students' positive attitude towards online reciprocal peer support. Students should have a positive attitude towards online reciprocal peer support, and the way in which it is organised (e.g. online and via instant messaging) should actually fit their support demands. In other words, the question is whether online reciprocal peer support is an appropriate support medium for students' support needs. This first requirement was studied in Chapters 3 and 4 (see next paragraph).
2) Sufficient peer competence and sustainability. The system should be able to select sufficiently competent peers for the support need at hand. Furthermore, a sufficient number of peers should remain willing to act as peer tutors during the period their support is needed, i.e. that the system should be sustainable. This second requirement was studied in Chapters 5 and 7(see next paragraph).
3) Sufficient support quality. In line with the requirement of peer competence, online reciprocal peer support should result in peers' answers that are of sufficient quality for tutees to continue studying, and the learning performance of students subjected to reciprocal online peer support should be high enough. This third requirement was studied in Chapters 6 and 7 (see next paragraph).

8.2 Main findings and conclusions

8.2.1 Students' positive attitude towards online reciprocal peer support

As part of the first requirement for online peer support systems, the study reported in Chapter 3 explored students' current IM use and their appreciation of an educational implementation. The central question was whether IM could be a suitable medium for online peer support. To that end a survey was conducted among students at a higher education institute in the Netherlands. 481 Students participated, of which the majority were aged 20-22. The participants came from various studies in arts, science and humanities. The following results were found:

- 74% of the respondents indicated to be using IM on a daily basis.
- Students are already using IM to cooperate on school tasks, give each other feedback, etc.
- Students would like to see IM being implemented in their learning environment.
- Younger students tend to use IM more intensively than their older peers do and they are also seemingly keener on trying new features of the medium.

It was concluded that IM is a promising medium for online peer support. Students indicate they are already familiar with IM and the medium enables them to get their support more quickly than is the case with peer support via asynchronous tools (such as discussion boards), which currently are more common (via Virtual Learning Environments (VLEs) such as BlackBoard or N@tschool). Only one-third of the population indicated they would like to see teacher guidance being available via IM. This might indicate that students prefer getting support from students when they ask for it via IM.

As part of the first requirement for online peer support systems, and to acquire a first idea of the feasibility of a system for online reciprocal peer support via instant messaging, a prototype of such a system was experimented with in a pilot study, reported in Chapter 4. The central question was to what extent a system for online reciprocal peer support is feasible and acceptable to students, and what factors influence these issues. A prototype of an online reciprocal peer support system was made available to students during a course. After the course period, a group of students was interviewed. The following results were found:

- Students had a positive attitude towards online reciprocal peer support only if other more traditional ways to get their support needs fulfilled were not expected to be better. It was not clear from the data whether this was due to technology preferences or preference for being tutored by either peers or teachers.
- In the context of this study, students indicated that in their opinion more traditional ways to get their support needs fulfilled were better.
- According to the students, the system failed to incite the feeling of availability of peer tutors. The system appeared to be unoccupied by peers, because it lacked any sign of (virtual) presence of potential peers, which asked for stimulants for the sense of availability of peers or virtual presence in future peer support systems.
- A method for automatically keeping track of students' progress, for example via a VLE, to determine peer competence is preferred over a solution in which students have to do that themselves, since students indicate this is time-consuming.
- The peer allocation algorithm used for the system was not able to provide a sufficient number of successful matches among the relatively small student group, as many tutor requests by students remained unanswered. The logging showed this was due to the algorithm's selection criteria, which successively excluded more students, even to the point that none were left. This revealed the need for a system for peer support that was able to cope with smaller student groups, by altering its parameters and possibly adding some extra allocation features.

It was concluded that an online reciprocal peer support system via IM could be a successful support tool provided it is applied in the right context in which alternatives to acquire support are not thought to be better. Also, to be able to serve smaller populations than the required 100 with the algorithm used, a new allocation algorithm capable of coping with smaller student populations was needed.

8.2.2 Sufficient peer competence and sustainability

In order to arrive at a peer support system that was suitable to serve populations smaller than 100 students, in Chapter 5 we presented the Synchronous Allocated Peer Support (SAPS) system, a support system for cohorts of students working on the same modular (i.e. chapters, topics, etc.)

learning material. Via this system, students with questions during their learning are allocated to competent fellow-students for answering. It uses instant messaging to connect students, since many students are already familiar with this medium in the context of supporting each other on study tasks (De Bakker et al., 2007).

For each specific question a student (tutee) has, a computer algorithm selects the most competent fellow student available in the peer group to act as peer tutor, based on the following selection criteria/parameters:

- Quality - proximity: prioritises peer candidates currently working on or having recently completed the same modular learning material as the tutee.
- Quality – question type: prioritises peer candidates who have indicated to be competent in the question type asked for by the tutee. What these questions types are depends on the context in which the system is applied, but examples would be ‘theoretical questions’ or ‘technical support questions’.
- Quality – previous result: prioritises peer candidates who have acquired high marks on e.g. courses with similar topics.
- Economy – favour-in-return: prioritises peer candidates who have already asked many questions themselves.
- Economy – uniformity: prioritises peer candidates who have previously had few tutor turns. NB: economy principles are useful to prevent overload of individual peer tutors by spreading the tutor load evenly among the population.

All peer candidates are given points on each of these selection criteria. The candidate with the highest total score is selected as peer tutor.

Figure 8.1 shows the SAPS allocation algorithm displaying the activity sequence from question to peer support chat session, as well as the allocation procedure and criteria used for matching students for the peer support activities.

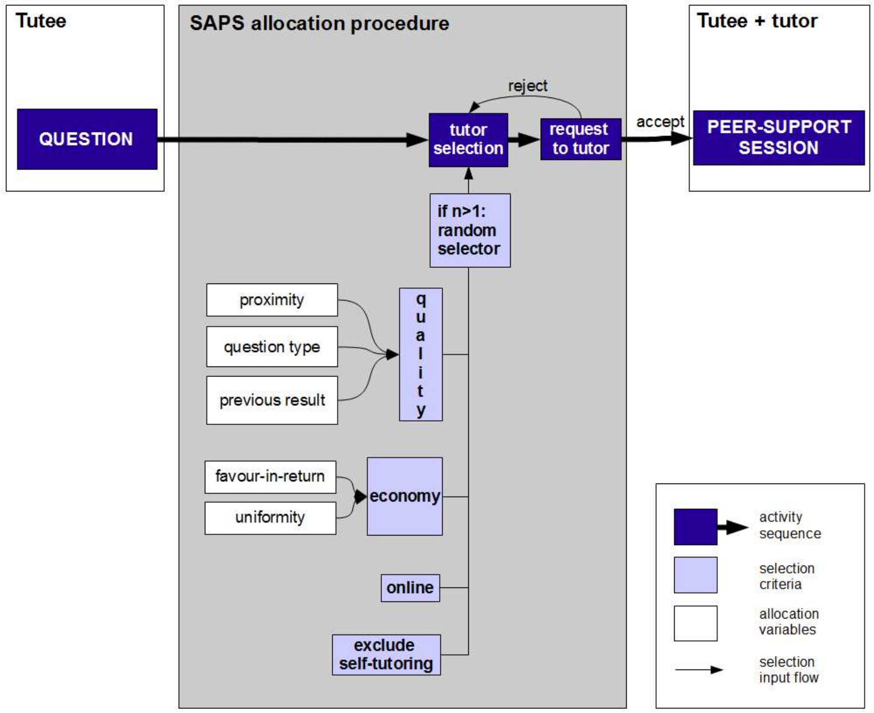

Figure 8.1: *The SAPS algorithm.*

The second requirement of our analysis of requirements for a peer support system to succeed is peer competence and sustainability of the system. Our aim was to arrive at the best possible setup of parameters that ensures that the system will select competent peers and will continue doing so during prolonged use (sustainability).

Simulations of systems in development, for example in a virtual simulation computer environment provide an opportunity to clarify causal relationships and interdependencies in a much more flexible manner (Gilbert & Troitzsch, 2005) than would be possible via empirical testing. In this way it is possible to examine the ideal setup of all the different parameters in a peer support system in development, before introducing it to students. Therefore we developed a simulation model of the SAPS system in the software environment NetLogo. The simulation led to the following results:

- Starting with a population size of 50, a sufficient number of competent peer tutors are selected. However, the allocation mechanism becomes more effective when more students are added, as more competent peers are selected and fewer questions remain unanswered.

- We introduced ‘question type’ and ‘previous result’ in the SAPS algorithm on top of the ‘proximity’ criterion (which is common in similar peer support systems) as extra quality selection criteria in the allocation process in order to enhance the general selection quality of the system. The introduction of these criteria leads to an increased quality of the selection algorithm, so they were incorporated in the final SAPS allocation algorithm.
- Many peer allocation mechanisms have economy principles incorporated (e.g. Van Rosmalen et al., 2006; Westera, 2007), which are used as parameters in the selection of peers to spread the tutor load evenly among the population. Thus, the selection algorithm can exclude peer candidates who have recently acted as peer tutor. Incorporating such parameters in the selection of peers can have some downsides as well. For example, when a part of a student population is not actively participating in peer support activities, selecting them because of tutor load concerns might result in tutees being confronted with unmotivated peers. Omitting the built-in economy principles from the allocation mechanism does not influence the mean number of tutor turns, but at the same time a larger spread of tutor turns occurs for all students selected as peer, which indicates the economy principles could be left out of the selection algorithm.
- Leaving out the economy principles increases the percentage of high-quality peers (i.e. peers that are given a high ranking score on one or more of the quality selection criteria by the allocation algorithm) that are selected to act as tutor. This further enhanced the general selection quality of the algorithm.

From the simulation it was concluded that allocation mechanisms such as implemented in the SAPS system should be able to facilitate online peer support activities among groups of students. The allocation mechanism holds over time and a sufficient number of students are willing and competent to answer fellow-students’ questions. Also, fine-tuning the parameters (e.g. extra selection criteria) of the allocation mechanism further enhances its effectiveness.

8.2.3 Sufficient support quality

The focus of Chapter 6 was to report on a field experiment conducted with the SAPS system. It focused on answer quality, learning performance and appreciation in the context of online reciprocal peer support. The following results were found in this empirical study:

- The majority (63%) of the answers given by peer tutors selected via the SAPS algorithm can be considered as solved based on experts' ratings. Experts rate teachers' answers higher (82% solved). Looking at the ratings themselves, the difference between peers' and teachers' ratings was not significant.
- 43% Of the answers given by peer tutors selected via the SAPS algorithm can be marked as solved according to students' ratings. Students rate teachers' answers slightly better (51% solved). Looking at the ratings themselves, the difference between peers' and teachers' ratings was not significant.
- The performance on multiple-choice tests of peer-supported students does not differ significantly from that of teacher-supported students.
- Students are generally more inclined to ask their questions to fellow-students instead of teachers, and consequently do so.
- Students perceive (a system for) online synchronous reciprocal peer support as useful and usable.

It was concluded that online reciprocal peer support using IM with the SAPS system's allocation algorithm is a proper alternative for teacher support on questions, when that is not available. The results of this study have shown that in terms of quality peer support is only slightly inferior to teacher support, and that peer-supported students do not perform worse than teacher-supported students on multiple-choice tests. No less important is the conclusion that the majority of the participating students valued an online reciprocal peer support system that uses instant messaging positively. The results were found in a face-to-face setting, in which student-teacher and student-student contact was still available during lectures. This could have influenced the outcomes, since it may have resulted in more complex questions not being asked via the system.

As part of the second and third requirement, Chapter 7 reported on an empirical study that was conducted to measure the peers' answer quality, their willingness to help fellow-students and students' attitude towards online peer support in a setting in which no teachers were available. To that end we made a free online self-study course available to a broad audience by announcing the course via a website of a Dutch distance university. 413 Participants started the course and 281 finished all course modules before the deadline. The majority of the participants were aged 41-70. The following results were found:

- The majority (57%) of the answers given by peer tutors selected via the SAPS algorithm in a setting in which teacher support is unavailable are rated with a 4 or 5 by both experts.
- The majority (51%) of the answers given by peer tutors selected via the SAPS algorithm in a setting in which teacher support is unavailable are rated with a 4 or 5 by students.
- 29% Of the tutee's questions are not answered by peers. However, many of these unanswered questions where situations in which chats where initiated (i.e. accepted by a tutor), but in which no communication took place. The data did not provide a clue to the reason for this, but it may have to do with the unfamiliarity of students with IM or with technical problems. When these as well as the cancelled requests by the tutee themselves are not counted, 16% of the questions posed remain unanswered, a percentage much closer to the hypothesized 10%.
- The number of rejections and requests ignored remained constant over time.
- The majority of students are generally satisfied with being supported by peers via an online peer support system, but IM is less appreciated for such purposes, which might be due to participants' unfamiliarity with the medium (as the majority is aged 41-70).

It was concluded that online reciprocal peer support using instant messaging with the SAPS allocation algorithm is a proper alternative for teacher support on questions, when teacher support is not available, as peers are able to answer the majority of fellow-students' questions. Important issues when implementing this form of support are students' willingness to answer fellow-students' questions and the participants' age, as this might be of influence on their attitude towards and their familiarity with an online reciprocal peer support system using instant messaging, which is possibly reflected in the outcomes of the study (e.g. the high percentage of unanswered questions).

8.2.4 General conclusions

We conducted this research project in the conviction that any system for this kind of student support should meet certain requirements. Therefore, our main conclusions will be discussed in the light of the requirements analysis framework introduced earlier.

1) Students' positive attitude towards online reciprocal peer support. The studies that were focused on the first requirement showed that students generally have a positive attitude towards online reciprocal peer support. Among younger students IM is a suitable medium for handling the support as well, older students are less keen on using the medium for such purposes.
2) Sufficient peer competence and sustainability. The SAPS system developed for the purpose of the research project has demonstrated its ability to provide competent peer tutors for answering questions. With regard to the system's sustainability, i.e. whether a sufficient number of peers remain willing to act as peer tutor over a longer usage period, students proved to be willing to answer fellow-students' questions via an online peer support system. Willingness could however be problematic in a context where the population is unfamiliar with IM, since it was found that in such a setting more questions remained unanswered.
3) Sufficient support quality. The studies that focused on the third requirement showed that the general quality of peers' answers is sufficient given the context of teacher unavailability. In various studies it was found that peers are able to answer the majority of fellow-students' questions sufficiently well. Also, peer-supported students' learning performance does not differ significantly from that of teacher-supported students.

In general, the studies conducted in the context of this research project indicate that an online reciprocal peer support system could serve as an appropriate alternative for teacher support when that is unavailable.

8.3 Reflection on the findings

Reflecting on the findings of the research project, we believe that two factors are critical for the potential success of online reciprocal peer support via IM. They are the actual as well as perceived *peer tutor competence* on the one hand and *technology use* on the other. The studies in this dissertation found that IM is an appropriate communication medium for handling the support itself, but that the characteristics of the population it is used in are key to its success.

8.3.1 Tutor competence

As in any form of peer support or peer tutoring, peer tutor competence is a crucial factor in a successful implementation of online reciprocal peer support. Peer competence has two elements that should be specifically noted here: *actual* peer competence and *perceived* peer competence. Actual competence refers to the objective competence of a peer tutor, as for example determined via experts' ratings of peers' answers. Perceived competence refers to the competence of a peer tutor as perceived by the tutee while getting the support. As for actual peer competence, the study reported in Chapter 6 showed that, when using the procedure of considering answers that were rated of 4 or 5 by both raters as solved, more teachers' answers than peers' answers were solved. However, since teachers are not able to answer all questions sufficiently well themselves (82%), peers do rather well as an alternative noting that they still answer 63% of the questions sufficiently well. Similar results were found in the empirical study reported in Chapter 7; peers were able to answer 57% of the questions sufficiently well. This brings up an issue of concern regarding the practical implications of the percentages described above. Our argument that the tutoring load of teachers can be decreased dramatically when peers answer some 60% of students' questions is only one side of the coin. While via the SAPS system proposed peers answer all questions, still a mechanism is needed to check which 40% is answered incorrectly and thus has to be answered by a more competent tutor such as a teacher. At the same time this 40% may consist of answers that are actually correct but not helpful enough to the tutee, while it is formulated too complicated for example. Currently perhaps the best candidate for a check on correctness versus helpfulness of an answer is the teacher, but this would cancel out the decreased workload achieved by introducing peer support. In order to solve this problem, the tutor competence of selected peers might be increased to get closer to the level of teachers' tutor competence. Van Rosmalen et al. (2008) found that with their peer allocation algorithm 75% of students' questions were solved, which indicates the selected peers generally had a greater tutor competence. This was probably due to the more sophisticated nature of the algorithm, which selected more peers per request and aided tutors in answering questions by providing them with additional information in the form of documents with content relevant to the question, and involved these peers in collaboratively answering the question in asynchronous mode using a wiki. Using this kind of allocation mechanism, peer support hardly differs from teacher support in the context of content-related questions, (75% questions solved by peers versus 82% questions solved by teachers). Such an adaptation to our peer support system would however be in contrast with its current lightweight character (i.e. only few assumptions on the learning content and participating students are needed), which makes implementation less time- and resource-consuming, but even more so with our aim to provide students with a synchronous peer support system that would enable them to receive the support needed more quickly.

The studies on answer quality also illuminate the issue of perceived competence. A high actual level of peer competence is of little value when students do not perceive it as such. To a certain degree this was the case in the studies conducted on this matter. In both empirical studies, fewer student-rated answers than expert-rated answers could be marked as solved. The clearest example was found in the study reported in Chapter 6. While 62% of peers' answers could be marked as solved according to experts' ratings, only 43% of the answers could be marked as solved according to students' ratings. Even when their negative rating of teachers' answers is taken into account (51% could be marked as solved), this raises the issue of peers' perceived answer quality, as students perceive peers' answers too negatively as we believe experts are more competent to determine the correctness of an answer than students are. Therefore, before being able to implement online reciprocal peer support via IM successfully, students' appraisal of the answers received via peer support should be further enhanced.

8.3.2 Generation differences in technology use

In line with previous surveys on the matter (PEW Internet, 2005; Qrius 2005), the IM survey reported in Chapter 3 showed that younger students use IM regularly (74% use it each day). Also in line with previous studies (Grinter & Palen, 2002), the survey showed students use IM for their studies. IM is used for educational activities such as support, feedback and cooperation. Based on these findings IM was chosen as the main technology to be used together with the reciprocal peer support system that was developed for this research project (which means that the allocation algorithm could also be used in cooperation with other communication tools). In the empirical study described in Chapter 6 this turned out to be an appropriate choice for the population of 20-28 year old students. The study described in Chapter 7 however showed different results. The participants in this study were about a generation older (the majority was aged 41-70) than the populations researched in the IM survey and the first empirical study. This influenced the use and appreciation of the support tool.

For example, the mean number of online users remained low during the entire course period, they were unfamiliar with IM, and they were less keen on using IM for online peer support activities. These issues probably caused the vast majority of peer support sessions in this study to take place via the asynchronous mode (offline chat) of the SAPS system. These results are in line with one of the findings of the IM survey (Chapter 3), which showed that the older the students, the less they used IM and the less they were willing to do so. Thus, a successful use of synchronous communication in a peer support context seems to remain somewhat limited to an audience of younger students who are familiar with being online regularly. From the perspective of the benefits of IM's synchronicity, which enables students to receive support quickly, it could however be argued that it is valuable to educate older student populations in IM acceptance and use.

This last finding leads to another important aspect of technology use. IM is especially popular among younger people, but it is uncertain if the medium is age bound or life phase bound. It might be that its use is connected to a certain period, which students grow out once they get older and their lives change. It might also be that IM remains popular with them irrespective of their eventual age. This is a question that can only be answered once the current generation among which IM became popular grows older. Looking at the recent corporate IM implementation wave, and the indicated usefulness of the medium in business contexts (Nardi et al., 2000), or predictions of IM dominance in the near future (Gartner, 2007) it is not to be expected that IM will be a medium of the past soon.

This issue also prompts the question of whether education should invest in new technologies from the moment they start developing. Should the field of educational technology invest its time in new technologies before they are proven and used commonly? At the time the choice was made to use IM together with the SAPS system, it was still unclear how the use of the medium would develop over time. Over the last years, educational technology has seen many new technologies and tools come and go. A recent example is the hype around virtual worlds and Second Life specifically. When popularity grew rapidly, many educational institutes saw potential in this medium and developed a virtual campus in Second Life in 2006 and 2007. Considering the decrease in active users since that period[8], one could argue that the investments in development made at the time were quite high, too high indeed. Virtual worlds do not seem to be as long lasting as once thought, so it could be questioned whether the effort put into exploring the technology was worthwhile for institutions. Along this line, it could be argued to be careful with extensive research into recent popular technologies such as serious gaming or web 2.0, of which IM is an example. At the same time a more conservative approach to educational technology could lead to innovation taking place slowly. Perhaps a push–pull strategy, a term originally from the field of logistics and supply chain management (Hinkelman, 1999), is a suitable compromise for these conflicting interests. Innovation through educational technology should always originate from educational demands from the field of education itself (pull). However, in order to be able to answer these demands quickly and effectively, it is as important that educational technologists keep track of new possibilities and innovations various fields, also outside education. This is made possible by researching and piloting such innovations (push).

8.4 Methodological considerations

The findings of this dissertation give rise to some methodological considerations: 1) tutor availability in the studies, 2) assumptions underlying the support system, and 3) generalisibility of the findings.

8.4.1 Tutor availability

The various findings on the quality of peer support reported on in this dissertation urge us to notice the aspect of tutor availability once more. The quality of a given tutor should be looked upon with its availability in mind. For example, in order to properly compare the answer quality of peers to that of teachers, in the study described in Chapter 6, it should be kept in mind that teachers were far more available than usual. During their office hours they were logged on to the SAPS system and therefore available to answer students' questions almost instantly. As teachers who designed the course themselves they were not surprisingly found to perform better. In a real-life context however, teachers would expectedly be available far less often and answer students' questions less promptly. In the same experiment, peers selected via the SAPS algorithm were found to be able to answer the large

[8] http://a-res.info/?p=160

majority of questions received from fellow-students' in ways sufficient for these students to continue their learning process. This means that students can be used to take over a significant portion of teachers' increasing tutoring load. At the same time, it is expected that especially the younger peers will be available to act as tutor more often since they are already familiar with being online more, for example via instant messaging. This was first found in the study reported on in Chapter 3, and later in the differences in familiarity with IM students themselves reported in Chapters 6 and 7. Along the same line it could be argued that systems such as SAPS would be best implemented among a group of younger students, and that populations of older students would be a less suitable audience.

8.4.2 Assumptions on peer support and its context underlying the SAPS system
In the development of our peer support system, a number of assumptions were made, mostly on learners' behaviour in an online peer support context. For some of these assumptions, we found empirical proof, for example students' tutor competence. In two studies we found proof that peers were able to answer the majority of fellow-students' questions sufficiently well. Another assumption underlying the support system is students' willingness to answer fellow-students' questions. In the empirical studies, no single answer was found on the question whether this assumption was true or false. In our first empirical study we found that peers accepted the vast majority of fellow-students' requests for answering questions, and that their willingness to do so remained constant over the course of the experiment. In our second empirical study we again found that willingness remained constant over time, but that a fair number of student requests (29%) remained unanswered. Although this high percentage of unanswered questions was partly influenced by initiated chats without communication (possibly due to the population's unfamiliarity with IM), willingness remains a less certain factor in our support system. Looking at similar work on this matter, it is worthwhile to note that Van Rosmalen et al. (2008) found an acceptable willingness rate, similar to that of our first empirical study (9% unanswered).

A last assumption that should be noted here is the study pace differences needed among students in order for the allocation algorithm to select peers based on 'proximity'. In settings in which all students study the same material at the same time, such as in face-to-face settings, it is useless to match students on 'proximity'. The modular approach of the SAPS allocation algorithm prevents this may become an issue, while if 'proximity' yields no competent peers, the other selection criteria still provide a chance to find them.

8.4.3 Generalisibilty of the findings

All the studies on online reciprocal peer support conducted in the scope of this research project took place in the context of higher education. Although one could argue that the conclusions of the dissertation are therefore limited to higher education, we believe that systems as SAPS could easily be applied to other educational contexts, given that certain conditions needed for the system to operate are met, for example that the learning content should be structured modularly or that the participants have to study in cohorts (see paragraph 8.5.1 for an overview of all conditions). Settings that meet such conditions can be found in various educational contexts. We therefore believe a system similar to SAPS could work in secondary education as well. It could for example be made available to pupils, allowing them to ask questions to fellow-students while doing their homework. A possible issue could be whether the peer competence of pupils in secondary education is sufficient and with that if the same results would be found for answered quality, since the competence gap between pupils and teachers is expected to be much higher at this age. However, the topics of the courses students were studying for the empirical studies of Chapters 6 and 7 were relatively new to most students, and even in these settings satisfying results were found in terms of answer quality.

The SAPS system was tested in distance as well as face-to-face education. In both settings we found encouraging results in terms of peer competence and peers' answer quality, as both in the empirical studies of Chapter 6 (face-to-face education) and Chapter 7 (distance education) the majority of the answers given by peers could be marked as solved based on experts' and students' ratings of those answers. It should however be noted again here that in some face-to-face settings the SAPS system in our view is less valuable. As indicated by some of the students in the first pilot study reported in Chapter 4, students in smaller groups (e.g. 20 students) are expected to know each other quite well. This lowers the barrier to contact fellow-students for support requests, but more importantly students probably have some knowledge of each other's competences. This likely enables them to more often contact the right peer for a given support request directly at once, not needing a system to select a peer for them. The gain of using an allocation system for connecting peers for support activities would probably be too little in relation to the investments needed for its implementation.

Possible generalisibility issues arise from the number of questions being asked on the courses around which both empirical studies were conducted (Chapters 6 and 7). In the first empirical study described in Chapter 6, students had contact with their teacher and fellow-students during the face-to-face lectures of the course. Although no data were gathered on this aspect, students might have asked some of their questions during these sessions instead of via the SAPS application while being at home. In Chapter 7 we tried to rule out this issue by making the SAPS system available in a setting where no teachers were present and no student-student contact was available outside the SAPS system. The course content of the second empirical study (Chapter 7) was however indicated not to be difficult by most course participants. At the same time, in both studies the majority of participants indicated they had quite some prior knowledge on the course subject already. These factors raise two issues. On the one hand they might have resulted in a relatively small number of questions being asked in both studies, making it less clear whether the SAPS system would still be able to select a sufficient number of competent peers when the number of support requests handled via the algorithm is (much) higher. On the other hand there is the issue that the degree of prior knowledge may have influenced the percentages of sufficiently answered questions found in both studies. It is therefore not as clear whether the results found could be generalised to contexts in which students possibly ask more questions, such as for example when the learning content is more complex to students or students have the option of asking teachers outside the system.

In the studies of this dissertation we marked answers that were rated with a 4 or 5 by both raters as solved. We believe that ratings of 4 or 5 given by experts on the course content are a proper indication of whether an answer is actually a good answer. The question remains however whether that answer actually helps a student to continue studying. We therefore asked the tutees to give a similar rating themselves. This lead to somewhat lower evaluations of the answers received, but that was also the case for students' evaluations of teachers' answers. In the scope of this research project we however did not compare the ratings of both the students and the experts one on one. In our opinion this could probably further enlighten the relationship between the actual correctness of an answer and its (perceived) helpfulness.

8.5 Practical implications

8.5.1 Practical outcomes

The research project has resulted in a system for online reciprocal peer support that can alleviate the tutor load of teachers, in contexts that have the following conditions:

1. Participants study in cohorts, for example students all follow a specific course or study program.
2. Students do not know each other well, since then they would know who to turn to with a specific question.
3. The learning material is structured modularly, for example a course that is structured in separate course modules or learning units.
4. Students study the learning material at different paces.
5. There is information available to determine a student's peer competence, in the form of one or more of the following:
    a. His or her progress in the learning material, e.g. his current course module or learning unit.
    b. His or her preferred question type.
    c. His or her past performance (on related learning material), e.g. in the form of marks on previous courses.

In contexts with such conditions, SAPS offers a system for peer support, while having some specific additional benefits that will be described in the following paragraphs. For a description of the global design of SAPS and the peer allocation algorithm (TutorAllocationAlgorithm), see Appendix 1.

8.5.2 Flexibility of the system

The modular setup of the SAPS system makes it easy to apply in different contexts. For example, if no data are available on students' preferred question types, the SAPS allocation algorithm can still select peer tutors based on the other quality parameters. The algorithm also allows one to prioritise certain parameters. Via the application of weights peer quality could be given priority over spreading the tutor load evenly among peers via the economy principles, or vice versa. For example, if the system is used in a context in which students hardly study online, the algorithm could be set up such that online students are not prioritised, while his would enhance peer quality.

8.5.3 Lightweight character of the system

The SAPS system offers a peer support system that requires little implementation effort compared to similar support systems (e.g. Van

Rosmalen et al., 2008), since only few data are needed to determine peer competence. At the same time the system needs few data on the course or study program it is being applied to. For example, in the context of a course the SAPS system only needs the course topics and possible question types for the course. It does not need the course content itself. These lightweight characteristics make the system time and with that cost efficient.

8.5.4 Software development

Complementary to the system itself, the research project resulted in a ready-to-use software artefact for online reciprocal peer support, which in its current form can be used alongside other educational software such as Virtual Learning Environments. However, connecting the SAPS system to existing communication tools such as already available IM tools might make its use more efficient and more user-friendly since users are already familiar with using those systems. A plug-in for e.g. Windows Live Messenger or Skype based on the SAPS algorithm could increase user accessibility and social presence, and at the same time lower development costs, while developers could concentrate on the development of the peer allocation algorithm primarily and not the eventual communication between tutors and tutees. Another option would be to integrate the SAPS system into existing VLEs.

8.6 Future research

The studies reported in this thesis give rise to a number of questions for further investigation.

8.6.1 Other support contexts

The empirical testing of the SAPS system thus far has been limited to the context of a single course. Further research could investigate whether applying the system to different support contexts would result in similar findings on answer quality and learning performance. For example, the SAPS system could be tested in a cross-year environment. Students in one of the pilots reported on in Chapter 4 already indicated they would like to see a similar system that would enable them to get in contact with more senior students to ask for their support, as such a system would lower the barrier for them to get into contact themselves. An important issue in such a context is whether students are willing to help junior students in fulfilling their support needs. In contrast with some of the cross-year approaches described by Topping (1996), a crucial element in the SAPS system is reciprocity. Systems in which senior students get credits for tutoring juniors could be a solution for the unbalanced reciprocal relationship between the two student groups. Also, the learning materials studied by the two groups need to be comparable.

8.6.2 Social aspects of peer support in online environments

Van Rosmalen (2008) mentions the importance of the community aspect of systems such as the one proposed in this dissertation. He argues that the formation of ad-hoc transient communities could be used as starting points for the formation of longer lasting communities (Fetter et al., in press). Students in this way could be motivated to continue contact with their peers in order to become less isolated. This offers an opportunity for distance education that suffers from many students dropping out during their studies. Research indicates that student dropout is influenced by the feeling of isolation and lack of social involvement (Ashar & Skenes, 1983; Tinto, 1993; Vann & Hinton, 1994). When students have the feeling of belonging to a community, there are fewer dropouts, the argument goes. One way to encourage community feeling is by increasing the number of student-student interactions. The students in the pilots also mentioned that the initial peer support system lacked the feeling of availability of peers. The measures taken in the research project to show them there were fellow-students available, by incorporating social presence notices as proposed by Kreijns (2004), that stated the number of online users, were too small to measure their influence on aspects of social presence and community feeling.

8.6.3 Empirical testing of the underlying support model

As noted previously, the research project did not find empirical proof for a number of assumptions made in the development of the SAPS system and the underlying support model. Further research could shed light on whether these assumptions hold in practice, such as for example the assumption of immediate availability of students via IM, which turned out to be not true in a setting of older student populations. More work should be done to clarify the actual reasons as to why this was the case, for which this Chapter presents some clues. At the same time, it should be investigated what could be expected of peer availability in such a setting.

8.6.4 Comparison of experts' and students' ratings

As stated previously there was a difference between the experts' and students' ratings of the same answers. Research could be done on comparing the two in order to gain better insights in the actual correctness of an answer and its (perceived) helpfulness, and the reason for students being less satisfied with answers then they could be based on the answers' correctness.

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Appendix 1 Global design of SAPS

The SAPS system is designed to facilitate online reciprocal peer support among students who are working on the same modular learning material. Below the global design of the system is presented.

SAPS identifies tutees (students who ask questions) and tutors (students who answer them). Students can have both roles.

SAPS allows the following actions for **tutees**:
1. Specifying a question (done by the tutee himself).
2. Allocating the tutee to a peer tutor via the Tutor Allocation Algorithm (TAA). The TAA is used to arrive at peer tutors who are assumed to be sufficiently competent to answer the tutee's question.
3. Interaction with the peer tutor to have the question answered.
4. Rating the interaction: determining the quality of the answer received (done by the tutee himself).

Figure 1 shows a schematic representation of SAPS' activity sequence from the tutee's perspective.

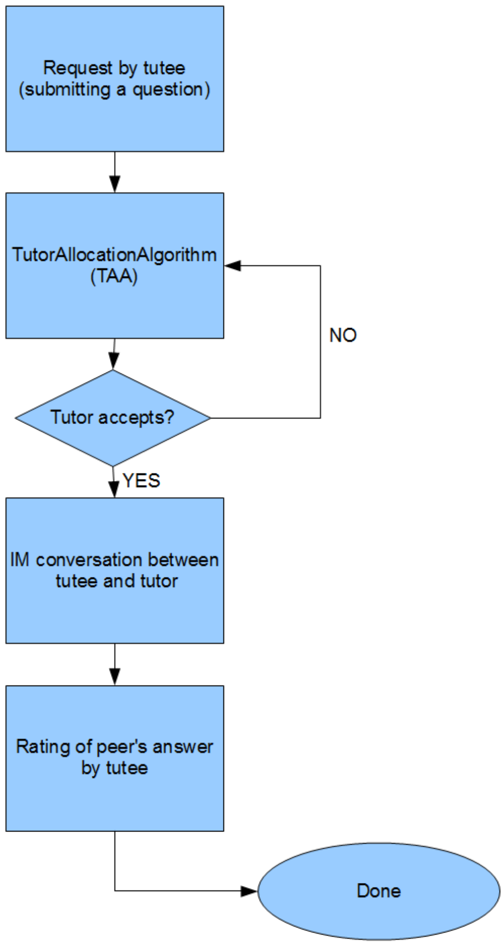

Figure 1: *The SAPS system from the tutee's perspective.*

SAPS allows the following actions for **peer tutors**:
(1) Accepting/rejecting a question request.
(2) Interaction with the tutee to answer the question.

TutorAllocationAlgorithm (TAA)

Upon a tutee's request, via the TutorAllocationAlgorithm (TAA) – which is the peer allocation mechanism in SAPS - the most competent peer tutor to answer that specific request is selected from the population of peer candidates (all fellow-students/course participants/etc.). In order to do so the TAA uses data stored in the SAPS system's database as well as data connected to the request of the tutee. The algorithm matches both data sets to arrive at the best tutee-tutor match. The tutee-tutor pair that is created via this process is limited to a specific request and with that to a short period. Figure 2 shows a schematic representation of the TAA.

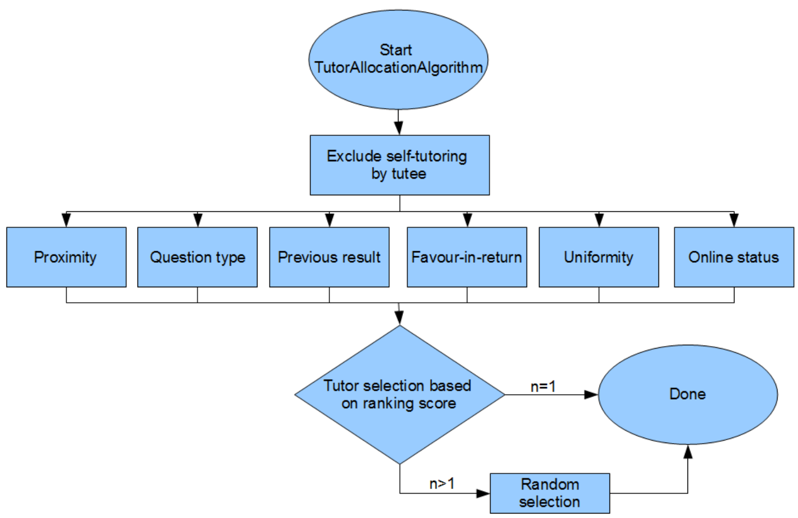

Figure 2: *The TutorAllocationAlgorithm (TAA).*

The TAA is based on three requirements: (1) providing sufficiently competent peers, (2) spreading the tutor load evenly among the population to prevent overloading individual peer tutors, and (3) prioritising online peers allowing quick support. Via six selection criteria, these requirements are incorporated in the algorithm. Based on these six criteria the eventual peer tutor for a given tutee's request is selected. Table 1 presents the criteria.

***Table 1:** Selection criteria of the TAA.*

Purpose/requirement	Criterion
Providing competent peers	Proximity Question type Previous result
Spreading the tutor load	Favour-in-return Uniformity
Prioritising online peers	Online status

Rules of the TAA

The TAA operates according to the following steps and rules:

1. Start TAA: the TAA is initiated upon a tutee submitting a request to the SAPS system. All students are marked as candidate peer tutors.
2. Exclude self-tutoring: the tutee is removed from the list of peer candidates.
3. Determining peer candidate ranking: SAPS selects the 'most competent' peer tutor. In order to determine this tutor, a ranking of the peer candidates is made by allocating points on each of the six selection criteria of the TAA. Points are given as follows:
    a. *Proximity:* this criterion prioritises peer candidates who are working on or who have recently completed the same learning unit (e.g. course module, book chapter) as the learning unit the tutee is working on. Based on an example course of 10 modules, each peer candidate receives points according to the following rules:

       IF SluS(i) >= Qlu(i) THEN proximityS(i) = 10 - (Slu – Qlu)
       IF SluS(i) >= Qlu(i) THEN proximityS(i) = 0

       in which:

Slu	- represents the learning unit a peer candidate is working on (Learning Unit)
Qlu	- represents the learning unit the tutee's question is about
S(i)	- represents student (i); a peer candidate
proximityS(i)	- represents the proximity score of student (i); a peer candidate

In order to be able to determine 'proximity', the SAPS system needs to know each student's finished and current learning units. These data could be gathered via automatic logging in the case of an online course (moment of starting on a learning unit, submitting a task/essay, making an online test), or via manual records the participants themselves have to submit.

b. *Question type:* this criterion prioritises peer candidates who are competent at answering certain question types (e.g. task-related questions, theoretical questions). The SAPS system uses a list of question types for each student indicating the ones they are competent at, for example:
    i. *Student 1: 1, 3, 5*
    ii. *Student 2: <empty>*
    iii. *Student 3: 4*

   Once a request is posted, the tutee indicates from a list of question types known to the system the question type he is looking for. The TAA matches the requested question type to the list of questions for each student.
   - If a peer candidate's question matches the question requested by the tutee, the TAA allocates 10 points to that candidate.
   - If there is no match, the peer candidate does not receive points.

   Question types could be gathered in various ways. A possible implementation would be to have the students themselves indicate their preferred question types. During the research project this implementation was chosen.

c. *Previous result:* this criterion prioritises peer candidates who have received high marks for previous similar courses. The TAA allocates points equal to the mark(s) previously acquired by each peer candidate.

d. *Favour-in-return:* this criterion prioritises peer candidates who have asked many questions themselves. The TAA uses the following rules to do so:

   IF questionsS(i) >= 10 THEN favour-in-return = 10

IF questionsS(i) < 10 THEN favour-in-return = questionsS(i)

in which:

questionsS(i)	- represents the number of questions asked by student (i); a peer candidate
S(i)	- represents student (i); a peer candidate
favour-in-return-S(i)	- represents student/peer candidate (i)'s favour-in-return score

e. *Uniformity:* this criterion spreads the tutor load evenly among the population by allocating additional points to those peer candidates who had the fewest tutor turns prior to the request. This is done according to the following rules:

IF turnsS(i) = 0 THEN uniformityS(i) = 10
IF turnsS(i) >= 1 THEN uniformityS(i) = (1 / turnsS(i)) * 5

in which:

turnsS(i)	- represents the number of tutor turns student/peer candidate (i) has had
S(i)	- represents student (i); a peer candidate
uniformityS(i)	- represents the uniformity score of student (i); a peer candidate

f. *Online status:* this criterion prioritises peer candidates who are online (logged on to the SAPS system) at the time of the request, by allocating them with an additional 10 points.

For all selection criteria, 10 points are allocated as a maximum.

Based on the points received on all of the selection criteria above a score ranking of all peer candidates is made, starting with the peer candidate with the highest number of points. The ranking is determined based on the following formula:

Selected tutor = S(i)MaxScore = (proximity*w1) + (question*w2) + (past performance*w3) + (favour-in-return*w4) + (uniformity*w5) + (login status check*w6) in which:

Selected tutor	- represents the selected tutor
S(i)MaxScore	- represents the student/peer candidate with the highest ranking in points
w(i)	- represents the weight of each selection criterion

In the TAA variable weights can be allocated to each of the selection criteria. This allows for more flexible implementations of the TAA, for example optimising it for situations in which peer competence of the selected tutors is more important than tutor load issues.

4. Tutor selection: in this step the peer candidate with the highest ranking score is selected as peer tutor. In a situation in which more than one candidates have the same highest ranking score, a random selection is made.
5. New selection?: if the selected peer tutor does not respond in time or if he rejects the request, a new peer tutor is selected from the list of candidates.

Appendix 2 Example conversation transcript

28/04/2009 10:05:41 **Tutee**
Hello. I have a question regarding the data analysis of our project task. Can the hypotheses that need to be examined be part of the pre and posttest comparison?

> *28/04/2009 10:06:14* **Tutor**
> Hello

28/04/2009 10:06:37 **Tutee**
Can you help me on this matter?

28/04/2009 10:06:54 **Tutee**
I really want to continue the data analysis, but I don't quite know where to start.

> *28/04/2009 10:07:26* **Tutor**
> yes, of course this is possible

28/04/2009 10:07:48 **Tutee**
so for example, those answers to the questions on attitude

> *28/04/2009 10:08:02* **Tutor**
> you can for example assume that they perform better after the project

28/04/2009 10:08:19 **Tutee**
that alone counts as a hypothesis?

28/04/2009 10:09:05 **Tutee**
I just mean: besides pre and post we do not need to formulate any more hypotheses?

> *28/04/2009 10:09:42* **Tutor**
> it would of course be interesting to also formulate another,

28/04/2009 10:10:04 **Tutee**
ok, that helps

> *28/04/2009 10:10:07* **Tutor**
> for example do girls perform better than boys

28/04/2009 10:10:09 **Tutee**
e.g. boys girls

28/04/2009 10:10:13 **Tutee**
yes indeed, I was thinking that

28/04/2009 10:10:25 **Tutee**
thanks

Summary

Allocated online reciprocal peer support via instant messaging as a candidate for decreasing the tutoring load of teachers

Influenced by various changes in higher education, such as an increase in learning independent of place and time, student populations have become increasingly heterogeneous. For example, with the increasing emphasis on self-regulation of students, teachers need to provide them with more individual tutoring. This increased need for guidance is reinforced by the younger students' expectations that others use modern communication tools the same way as they do themselves (Prensky, 2001; Simons, 2006). The increasing need for guidance among students increases teachers' tutoring workload (Fox & MacKeogh, 2003; Rumble, 2001). According to teachers, the answering of student questions is time-consuming (De Vries et al., 2005). As attempts to solve this problem systems for online reciprocal peer support have been introduced (e.g. Van Rosmalen et al., 2006; Sloep et al., 2007). In these cases, questions students have while studying are answered by fellow-students acting as peer tutors. Reciprocal here refers to the roles both the tutee and tutor can adopt. An important characteristic of such systems is that the allocation of peers is not self-regulated, as is for instance the case when using bulletin boards, but that peer tutors are allocated based on their competence to answer specific questions. This has some important benefits, as pointed out by Westera (2007): a) someone become explicitly responsible to offer the support, b) the likelihood of support becoming available is increased, c) allocation results in the selection of the most competent peer tutor, d) the time before getting an answer can be reduced, e) peer tutor load can be distributed more evenly over the population.

Previous initiatives for online peer support systems have some drawbacks, since the support is given asynchronously (Van Rosmalen et al., 2006) or the system needs larger populations to operate properly (Westera, 2007). This dissertation introduces the SAPS system (Synchronous Allocated Peer Support) that is suitable for smaller population sizes and provides students with support more quickly. Via this system, students' questions are forwarded to competent fellow-students for answering. The support takes place via instant messaging (IM). The SAPS system is designed to support reciprocal peer support activities among populations who are working on the same modular material, such as courses with separate chapters.

As any such system should meet certain requirements in order to be able to lay a claim to success, an analysis of the following requirements was conducted:

1. Students' positive attitude towards online reciprocal peer support. Students should have a positive attitude towards online reciprocal peer support. The way in which it is organised (e.g. online and via instant messaging) should actually fit their support demands. In other words, online reciprocal peer support should be an support medium appropriate to students' support needs. This first requirement was studied in Chapters 3 and 4.
2. Sufficient peer competence and sustainability. Via the system, sufficiently competent peers for the support need at hand should be selected. Furthermore, a sufficient number of peers should remain willing to act as peer tutors during the period their support is needed, i.e. that the system should be sustainable. This second requirement was studied in Chapters 5 and 7.
3. Sufficient support quality. In line with the requirement of peer competence, online reciprocal peer support should result in peers' answers that are of sufficient quality for tutees to continue studying, and the learning performance of students subjected to reciprocal online peer support should be high enough. This third requirement was studied in Chapters 6 and 7.

Requirement 1: students' positive attitude towards online reciprocal peer support

As part of the first requirement, the study in Chapter 3 explored students' current IM use and their appreciation of a possible educational implementation. The central question was whether IM could be a suitable medium for online peer support. A survey was conducted among students at a higher education institute in the Netherlands, in which 481 students participated. The majority of the participants were aged 20-22, and they came from various disciplinary backgrounds. The following results were found:

- 74% Of the respondents indicated to be using IM on a daily basis.
- Students are already using IM to cooperate on school tasks, give each other feedback, etc.
- Students would like to see IM being implemented in their learning environment.

- Younger students tend to use IM more intensively than their older peers do and they are also seemingly keener on trying new features of the medium.

It was concluded that IM is a promising medium for online peer support. Students indicate they are already familiar with the medium and that it enables them to get their support more quickly than is the case with currently common asynchronous peer support tools (such as discussion boards), in Virtual Learning Environments (VLEs) such as BlackBoard or N@tschool). Only a third of the respondents indicated they would like to be guided by teachers via IM. This might indicate that students through IM prefer getting support from students.

Also as part of the first requirement a pilot study was conducted, as is reported in Chapter 4. The central question was to what extent a system for online reciprocal peer support is feasible and acceptable to students, and by what factors these issues are influenced. The prototype was made available to students during a course. After the test phase, a group of students was interviewed. The following results were found:

- Students had a positive attitude towards online reciprocal peer support, but only if other more traditional ways to have their support needs fulfilled were not expected to be better. The interview data did not clarify whether this was due to students' technology preferences or a preference for teacher rather than peer tutoring.
- For this study specifically, students indicated that in their opinion more traditional ways to get their support needs fulfilled were better.
- The students noted that the system failed to incite the feeling of availability of peer tutors. The system appeared unoccupied by peers, because it lacked any indication of (virtual) presence of potential peers. This asked for stimulants for the sense of availability of peers or virtual presence in future peer support systems.
- Automatically that automatically keeps track of study progress (used to determine peer competence), for example via a VLE, is preferred over a situation in which students have to do that themselves, they find this time-consuming.
- On a technical level, the peer allocation algorithm used for the system was not able to provide a sufficient number of successful

matches among the relatively small student group, as many of the tutees' requests remained unanswered. The logging data showed this was caused by the algorithm's selection criteria, which successively excluded more students, even to the point that none were left.

For the first requirement it was concluded that an online reciprocal peer support system via IM could be a successful support tool provided it is applied in a context in which alternatives to acquire support are not expected to be better. Also, to be able to serve populations smaller than the 100 the algorithm used in the pilot study required, a new allocation algorithm is needed.

Requirement 2: sufficient peer competence and sustainability
Chapter 5 introduces the Synchronous Allocated Peer Support (SAPS) system, which is based on a new algorithm. SAPS is a support system for cohorts of students who work on the same modular learning material, such as chapters, topics or course modules. SAPS still forwards students' study questions to competent fellow-students. It also uses instant messaging as the support medium> IM was kept since students already use IM to support each other on study tasks (De Bakker et al., 2007).

To arrive at the most competent peer tutor for a specific question, the new computer algorithm uses the following selection criteria/parameters:

- Quality - proximity: prioritises peer candidates currently working on or having recently completed the same modular learning material as the tutee.
- Quality – question type: prioritises peer candidates who have indicated to be competent in the type of question asked by the tutee. What these question types are depends on the context in which the system is applied, but examples would be 'theoretical questions' or 'technical support questions'.
- Quality – previous result: prioritises peer candidates who have acquired high marks on e.g. courses with similar topics.
- Economy – favour-in-return: prioritises peer candidates who have already asked many questions themselves.
- Economy – uniformity: prioritises peer candidates who have previously had few tutor turns. NB: economy principles are useful to

prevent overload of individual peer tutors by spreading the tutor load evenly among the population.

All peer candidates are given points on each of these selection criteria. The candidate with the highest total score is selected as peer tutor.

The second requirement of the requirements analysis was sufficient peer competence and sustainability of the system. In order to find out whether the present (SAPS) system with the new algorithm ensures that the most competent peers are selected and that students remain sufficiently willing to help each other (sustainability), a simulation study was conducted. The following results were found:

- A sufficient number of competent peer tutors are selected in student populations counting as few as 50 students (but not fewer). However, the allocation algorithm is able to select a larger number of competent peers and fewer questions remain unanswered as the population increases in size.
- In order to enhance the general selection quality of the system, 'question type' and 'previous result' were introduced as extra selection criteria on top of 'proximity' which is common in similar peer support systems. These criteria result in a larger number of competent peers being selected.
- Many peer allocation systems incorporate mechanisms to spread the tutor load evenly among the population (e.g. Van Rosmalen et al., 2006; Westera, 2007). As removing such mechanisms can have benefits, such as not selecting unmotivated peers who are not actively participating in the peer support activities, it was tested whether not incorporating such a mechanism lead to an overload of individual peers. This turned out not to be the case.
- Not implementing a tutor load spread mechanism increases the percentage of high-quality peers (i.e. peers that are given a high ranking score on one or more of the quality selection criteria by the allocation algorithm) that are selected by the algorithm.

It was concluded that the SAPS allocation algorithm simulated is superior to the algorithm used previously: it should be able to facilitate online peer support activities among groups of students, as a sufficient number of students remain willing and are competent to answer fellow-students' questions. Also, fine-tuning the parameters (e.g. adding extra selection criteria) enhances the effectiveness of the algorithm.

Requirement 3: sufficient support quality

Chapter 6 reported on an empirical study on answer quality, learning performance and student appreciation of online reciprocal peer support and the SAPS system specifically. The following results were found:

- Based on experts' ratings, the majority (63%) of the answers given by peer tutors selected via the SAPS algorithm can be considered as a solution to the question asked. Experts rate teachers' answers higher than peer tutors' answers (82% solved). Looking at the ratings themselves, the difference between peers' and teachers' ratings was not significant.
- Based on students' ratings, 43% of the answers given by peer tutors selected via the SAPS algorithm can be marked as a solution to the question asked. Students rate teachers' answers slightly better (51% solved). Looking at the ratings themselves, the difference between peers' and teachers' ratings was not significant.
- Peer-supported students' do not perform significantly worse or better on multiple-choice tests than do teacher-supported students.
- Students are generally more inclined to ask their questions to fellow-students instead of teachers, and consequently do so.
- A system for online synchronous reciprocal peer support is perceived as useful and usable by students.

It was concluded that online reciprocal peer support on questions via the SAPS system is a proper alternative for teacher support when that is not available. In terms of quality, peer support is only slightly inferior to teacher support, and peer-supported students do not perform worse than teacher-supported students on multiple-choice tests. No less important is the conclusion that the majority of the participating students appreciate an online reciprocal peer support system that uses instant messaging. The results could have been influenced by the fact that they were found in a face-to-face setting, in which student-teacher and student-student contact was still available during lectures. This may have resulted in more complex questions not being asked via the system.

As part of the second and third requirement, Chapter 7 describes an empirical study is described that was conducted to measure the peers' answer quality, their willingness to help each other and students' attitude towards online peer support in a setting in which no teachers were available. The SAPS system was made available to participants in an online self-study course. Most participants were aged 41-70. The following results were found:

- Experts rate the majority (57%) of peers' answers in a setting in which teacher support is unavailable with a 4 or 5 on a 5 point Likert scale. Therefore the majority of the answers is considered solved.
- Students rate the majority (51%) of peers' answers in a setting in which teacher support is unavailable with a 4 or 5 on a 5 point Likert scale. Therefore the majority of the answers is considered solved.
- 29% Of the questions asked by students remain unanswered, far more than the 10% hypothesised. However, many of these unanswered questions where situations in which no communication took place, though chats where initiated (i.e. accepted by a tutor). The data did not provide a clue to the reason for this, but it may have to do with the unfamiliarity of students with IM or with technical problems. When these as well as the cancelled requests by the tutee themselves are not counted, 16% of the questions posed remain unanswered, a percentage much closer to the hypothesized 10%.
- The percentage of unanswered questions remains constant over time.
- Most students are satisfied with being supported by peers via an online peer support system. IM is however less appreciated for such purposes, which might be due to participants' unfamiliarity with the medium, as the largest group was aged 41-70.

It was concluded that online reciprocal peer support via the SAPS system is a proper alternative for teacher support if that is unavailable, as peers answer the majority of fellow-students' questions sufficiently well. Important issues are students' willingness to help each other and the participants' age, as this might influence their attitude towards and their familiarity with an online reciprocal peer support system using instant messaging, which is possibly reflected in the outcomes of the study (e.g. the high percentage of unanswered questions).

Discussing the main findings in the light of the requirements analysis framework introduced earlier the following overall conclusions can be drawn from the entire study.

1 <u>Students' positive attitude towards online reciprocal peer support</u>. Students generally appreciate online reciprocal peer support. Among

younger students IM is a suitable medium for handling the support, older students are less keen on and less familiar with using the medium appropriately for such purposes.

2. Sufficient peer competence and sustainability. The SAPS system has demonstrated its ability to select competent peer tutors for answering questions. Regarding the system's sustainability, students are willing to answer fellow-students' questions. Willingness could however be problematic when students are unfamiliar with IM, since it was found that in such a setting more questions remain unanswered.
3. Sufficient support quality. The general quality of peers' answers is sufficient given the context of teacher unavailability. Peers are able to answer the majority of fellow-students' questions sufficiently well. Importantly, peer-supported students' learning performance does not differ significantly from that of teacher-supported students.

In general, the studies conducted in the context of this research project indicate that an online reciprocal peer support system could serve as an appropriate alternative for teacher support when that is unavailable.

Samenvatting

Gealloceerde wederkerige online peer-begeleiding met behulp van instant messaging als mogelijke oplossing om de begeleidingsdruk van docenten te verlagen

Onder invloed van diverse veranderingen in het hoger onderwijs, zoals een toename van tijd- en plaatsonafhankelijk leren, worden studentpopulaties steeds heterogener. Zo is bijvoorbeeld zelfregulatie in opkomst, waardoor docenten steeds meer individuele begeleiding aan studenten moeten geven. Deze toegenomen begeleidingsbehoefte wordt versterkt door de verwachting van jongere studenten dat anderen moderne communicatiemiddelen op eenzelfde wijze gebruiken als zijzelf (Prensky, 2001; Simons, 2006). De toenemende begeleidingsbehoefte onder studenten zorgt voor een toename van de begeleidingsdruk van docenten (Fox & MacKeogh, 2003; Rumble, 2001). Docenten geven aan dat het beantwoorden van vragen van studenten tijdrovend is (De Vries et al. 2005). Diverse initiatieven proberen een oplossing voor dit probleem te bieden door systemen voor online wederkerige peer-begeleiding te introduceren (bv. Van Rosmalen et al. 2006; Sloep et al. 2007; Westera, 2007). Via deze systemen worden studenten die tijdens het studeren een vraag hebben gekoppeld aan medestudenten die als peer-begeleider optreden. Met wederkerig wordt in dit verband bedoeld dat studenten zowel vraagsteller (tutee) als begeleider (tutor) kunnen zijn. De toewijzing van peers aan vraagstellers is in dit geval niet zelfgestuurd zoals dat het geval is bij bijvoorbeeld een webforum, maar vindt plaats via de directe toewijzing van peers op basis van hun competentie om specifieke vragen te beantwoorden. Dit biedt volgens Westera (2007) een aantal belangrijke voordelen: a) iemand wordt expliciet verantwoordelijk voor het bieden van de begeleiding, b) de kans dat begeleiding daadwerkelijk wordt gegeven wordt verhoogd, c) toewijzing zorgt ervoor dat de meest competente peer-begeleider geselecteerd wordt, d) de tijd voordat een antwoord gegeven wordt kan worden verkort, e) de begeleidingslast kan evenredig over de peer-begeleiders worden verdeeld.

Eerdere soortgelijke initiatieven met dergelijke systemen hebben een aantal belangrijke nadelen. Zo zijn zij alleen geschikt voor grote studentpopulaties (Westera, 2007) of wordt de begeleiding asynchroon geboden (Van Rosmalen et al., 2006), hetgeen een wachttijd oplevert voor de vraagsteller. De focus van deze dissertatie is gericht op een nieuw systeem voor online peer-begeleiding dat geschikt is voor kleine studentpopulaties en dat studenten snel van de gevraagde begeleiding kan voorzien: het SAPS-systeem

(Synchronous Allocated Peer Support). Dit systeem koppelt studenten die tijdens het studeren een vraag hebben aan medestudenten die deze vraag op basis van hun competentie zouden moeten kunnen beantwoorden. De begeleiding vindt plaats via instant messaging (IM). Het SAPS-systeem ondersteunt wederkerige peer-begeleiding onder een groep studenten die aan hetzelfde modulaire lesmateriaal werken, zoals een cursus die is opgebouwd uit afzonderlijke hoofdstukken.

Deze dissertatie gaat in op de haalbaarheid van het hierboven beschreven systeem, aan de hand van een analyse van de vereisten waar zulk een systeem aan moet voldoen om succesvol ingezet te kunnen worden. Deze vereisten zijn:

1) Positieve houding van studenten ten opzichte van online wederkerige peer-begeleiding. Studenten moeten een positieve houding ten opzichte van online wederkerige peer-begeleiding hebben en de wijze waarop het georganiseerd is (online en via instant messaging) dient aan te sluiten bij hun begeleidingsbehoeften. Met andere woorden, de vraag is of online wederkerige peer-begeleiding de potentie heeft een succesvol begeleidingsmedium te zijn. Deze eerste vereiste werd onderzocht in hoofdstuk 3 en 4.
2) Voldoende competente peers en duurzaamheid van het systeem. Het systeem dient peers te selecteren die voldoende competent zijn om het antwoorden te kunnen geven. Daarnaast dienen voldoende peers bereid te zijn hun medestudenten te helpen en dat voor langere tijd te blijven doen (duurzaamheid van het systeem). Dit tweede vereiste werd onderzocht in hoofdstuk 5 en 7.
3) Begeleiding van voldoende kwaliteit. In lijn met het vereiste van competente peers dient online wederkerige peer-begeleiding te resulteren in door peers gegeven antwoorden van dusdanige kwaliteit dat vraagstellers verder kunnen met studeren. Bovendien dienen de resultaten van studenten die met online wederkerige peer-begeleiding werken hoog genoeg te zijn. Dit derde vereiste werd onderzocht hoofdstuk 6 en 7.

Eerste vereiste: positieve houding van studenten ten opzichte van online wederkerige peer-begeleiding

Als onderdeel van het eerste vereiste voor online wederkerige peer-begeleidingssystemen ging de in hoofdstuk 3 beschreven studie in op het huidige IM-gebruik van studenten en hun mening over een educatieve implementatie ervan. De centrale vraag luidde of IM een passend medium kan zijn voor online peer-begeleiding. Hiertoe werd een enquête gehouden onder studenten aan een Nederlandse hoger onderwijsinstelling. 481 Studenten namen deel, van wie het grootste deel tussen de 20 en 22 jaar oud was. De participanten studeerden aan diverse opleidingen in verschillende richtingen. De volgende resultaten werden gevonden.

- 74% van de ondervraagden gaf aan IM dagelijks te gebruiken.
- Studenten gebruiken IM om samen te werken aan opdrachten, elkaar feedback te geven, etc.
- Studenten zouden IM in hun onderwijsomgeving terug willen zien.
- Jonge studenten gebruiken IM intensiever dan oude studenten en ze lijken meer interesse te hebben in het uitproberen van nieuwe mogelijkheden van het medium.

Op basis van het onderzoek werd geconcludeerd dat IM een veelbelovend medium voor online peer-begeleiding kan zijn. Studenten geven aan dat zij al bekend zijn met het medium. Bovendien biedt het hen de mogelijkheid sneller begeleiding te krijgen dan dat mogelijk is via asynchrone toepassingen zoals webfora die momenteel meer gangbaar zijn in ElektronischeLeerOmgevingen (ELO's) als BlackBoard en N@tschool. Slechts een derde van de ondervraagden gaf aan via IM door docenten te willen worden begeleid, hetgeen erop zou kunnen duiden dat studenten de voorkeur geven aan begeleiding door studenten via IM.

Als onderdeel van het eerste vereiste voor online peer support systemen en om een eerste idee te krijgen van de haalbaarheid van een systeem voor online wederkerige peer-begeleiding via instant messaging, werd een prototype van een dergelijk systeem uitgetest in een pilot-studie, welke wordt beschreven in Hoofdstuk 4. De centrale vraag luidde in hoeverre een systeem voor online wederkerige peer-begeleiding haalbaar is en wordt aanvaard door studenten en welke factoren hierop van invloed zijn. Tijdens een cursus hadden studenten de beschikking over het prototype. Na afloop van de cursusperiode werd een groep studenten geïnterviewd. De volgende resultaten werden gevonden:

- Studenten hadden een positieve houding ten aanzien van online wederkerige peer-begeleiding, tenzij ze van mening waren dat andere meer traditionele begeleidingsvormen hun begeleidingsbehoeften beter konden vervullen. Uit de data kwam niet naar voren of dit te wijten was aan hun technologievoorkeur of een voorkeur was voor docent- dan wel peer-begeleiding.

- In het specifieke geval van deze studie waren studenten van mening dat andere, meer traditionele begeleidingvormen beter bij hun behoeften aansloten.
- Volgens de studenten liet het systeem niet zien of er peer-begeleiders beschikbaar waren. Er leken geen medestudenten in het systeem aanwezig te zijn doordat er geen indicatoren van (virtuele) aanwezigheid van potentiële peers waren.
- Een methode waarin studievoortgang automatisch wordt bijhouden (gebruikt om peer-competentie te bepalen), bijvoorbeeld via een ELO, verdient de voorkeur boven een methode waarbij studenten dit zelf moeten doen, omdat dit te tijdrovend is volgens de studenten.
- Het peer-allocatie-algoritme dat in het systeem gebruikt werd bleek niet in staat een voldoende aantal succesvolle toewijzingen van peers te bieden onder de relatief kleine groep studenten. Veel verzoeken van vraagstellers bleven onbeantwoord. De logging-data toonden aan dat dit te wijten was aan de selectiecriteria van het algoritme dat achtereenvolgens steeds meer studenten uitsloot totdat er geen geschikte peer overbleef. Hieruit bleek de noodzaak voor een systeem dat in staat was kleinere groepen te bedienen, door het wijzigen en eventueel toevoegen van selectiecriteria.

Op basis van de resultaten werd geconcludeerd dat een online wederkerig peer-begeleidingssysteem via IM een geschikte begeleidingsvorm kan bieden op voorwaarde dat het wordt toegepast in een context waarin alternatieven voor het verkrijgen van begeleiding niet beter worden geacht. Bovendien bleek een nieuw allocatiealgoritme nodig dat om kon gaan met kleinere studentpopulaties dan de benodigde 100 studenten waarvoor het gebruikte algoritme eigenlijk bedoeld was.

Tweede vereiste: voldoende competente peers en duurzaamheid van het systeem

In hoofdstuk 5 werd het Synchronous Allocated Peer Support (SAPS) systeem (synchroon gealloceerde peer-begeleiding) geïntroduceerd, dat op een nieuw algoritme is gebaseerd. SAPS is een begeleidingssysteem gericht op studentpopulaties die werken aan dezelfde modulair gestructureerde leerstof, zoals hoofdstukken, onderwerpen of cursusmodulen. Via SAPS worden vragen van studenten doorgestuurd naar competente medestudenten zodat deze de vraag kunnen beantwoorden. Het systeem maakt gebruik van instant messaging om de communicatie tussen studenten te bewerkstelligen, omdat studenten dit medium reeds gebruiken om elkaar hulp te bieden op studiegerelateerde zaken (De Bakker et al., 2007).

Om te bepalen welke peer-begeleider het meest geschikt is om een specifieke vraag te beantwoorden, doorloopt een computeralgoritme de volgende selectiecriteria:

- Kwaliteit - nabijheid: geeft voorrang aan peer-kandidaten die momenteel aan hetzelfde onderdeel werken of het recentelijk hebben afgerond.
- Kwaliteit – vraagtype: geeft voorrang aan peer-kandidaten die hebben aangegeven competent te zijn in het geven van antwoorden op het door de vraagsteller aangegeven vraagtype. Welke vraagtypen dit zijn hangt af van de context waarin het SAPS-systeem wordt ingezet, maar mogelijke voorbeelden zijn 'theoretische vragen' of 'vragen om technische ondersteuning'.
- Kwaliteit – eerder resultaat: geeft voorrang aan peer-kandidaten die hoge cijfers hebben gehaald voor bijv. cursussen met vergelijkbare onderwerpen.
- Beheer – terugbetaling: geeft voorrang aan peer-kandidaten die zelf veel vragen hebben gesteld.
- Beheer – uniformiteit: geeft voorrang aan peer-kandidaten die nog weinig tutorbeurten hebben gehad. NB: beheersmechanismen zijn nuttig om de overbelasting van individuele peer-begeleiders te voorkomen door de begeleidingslast evenredig over de populatie te verspreiden.

Op elk van deze selectiecriteria krijgen alle peer-kandidaten een puntenscore toegekend. De kandidaat met het hoogste aantal punten wordt uiteindelijk als peer-begeleider geselecteerd.

De tweede vereiste van de requirements-analyse was voldoende competente peers en duurzaamheid van het systeem. Om het algoritme zodanig te ontwikkelen dat het de meest competente peers selecteert hebben en dat studenten bovendien via het systeem bereid blijven om elkaar te helpen (duurzaamheid), werd een simulatiestudie met een model van het SAPS-allocatiealgoritme uitgevoerd. Hierin werden de volgende resultaten gevonden:

- Het algoritme is in staat een voldoende aantal competente peers te selecteren onder populaties van ten minste 50 studenten. Echter, naarmate de populatie in omvang toeneemt selecteert het algoritme steeds grotere aantallen competente peers en blijven minder vragen onbeantwoord.
- Om de algemene selectiekwaliteit van het systeem te verbeteren werden naast 'nabijheid' (gebruikelijk in vergelijkbare peer-begeleidingssystemen) ook 'vraagtype' en 'eerder resultaat' als extra selectiecriteria geïntroduceerd. De toevoeging van deze criteria zorgt ervoor dat een groter aantal competente peers wordt geselecteerd. Daarom worden ze opgenomen in de definitieve versie van het SAPS-algoritme.
- Veel peerallocatiesystemen beschikken over mechanismen om de begeleidingslast voor peers gelijkmatig over de studentpopulatie te verdelen (bv. Van Rosmalen et al., 2006; Westera, 2007). Het niet opnemen van dergelijke mechanismen in het selectieproces kan echter ook voordelen hebben, zoals het niet in de selectie meenemen van voor peer-begeleiding ongemotiveerde studenten. De simulatie toonde aan dat het weglaten van een dergelijk mechanisme niet tot een overbelasting van individuele peers leidde.
- Door het niet opnemen van mechanismen voor het spreiden van de begeleidingslast over alle peers worden door het algoritme competentere peers geselecteerd (peers met een hogere totaalscore op een of meer van de selectiecriteria van het toewijzingsalgoritme). Hierdoor wordt de kwaliteit van het algoritme verder verhoogd.

Geconcludeerd kan worden dat het SAPS-allocatiealgoritme in staat zou moeten zijn online peer-begeleidingsactiviteiten onder studenten te faciliteren, aangezien een voldoende aantal studenten bereid blijft en competent genoeg is om vragen van medestudenten te beantwoorden. Het verder verfijnen van de selectiecriteria, zoals het toevoegen van extra criteria, zorgt voor een verbeterde effectiviteit van het algoritme.

Derde vereiste: begeleiding van voldoende kwaliteit

Hoofdstuk 6 rapporteerde over een empirische studie naar antwoordkwaliteit, leerprestaties en studentwaardering van een systeem voor online wederkerige peer-begeleiding en het SAPS-systeem in het bijzonder. De volgende resultaten werden gevonden:

- Op basis van expertratings kon de meerderheid (63%) van de antwoorden van door SAPS geselecteerde peers als opgelost worden beschouwd. Experts gaven de antwoorden van docenten iets hogere beoordelingen (82% opgelost). Kijkend naar de beoordelingen zelf blijkt het verschil tussen de door peers begeleide en door docenten begeleide groepen echter niet significant.

- Op basis van studentratings kon 43% van de antwoorden van door SAPS geselecteerde peers als opgelost worden beschouwd. Studenten gaven de antwoorden van docenten hogere beoordelingen (51% opgelost). Kijkend naar de beoordelingen zelf blijkt het verschil tussen de door peers begeleide en door docenten begeleide groepen echter niet significant.
- De prestaties op multiple-choice toetsen van door peers begeleide studenten verschillen niet significant van die van door docenten begeleide studenten.
- Studenten zijn over het algemeen meer geneigd om medestudenten vragen te stellen in plaats van hun vragen aan docenten te stellen. Over het algemeen stellen zij dan ook meer vragen aan medestudenten dan aan docenten.
- Een systeem voor online wederkerige peer-begeleiding met behulp van IM wordt door studenten als nuttig en bruikbaar ervaren.

Geconcludeerd mag worden dat online wederkerige peer-begeleiding bij vragen via het SAPS-systeem een volwaardig alternatief voor docentbegeleiding is wanneer deze niet beschikbaar is. Kijkend naar antwoordkwaliteit blijken peers het net iets minder goed dan docenten te doen als gekeken wordt naar de hoeveelheid opgeloste vragen. Door peers begeleide studenten presteren op multiple-choice toetsen niet slechter dan door docenten begeleide studenten. Eveneens een belangrijke conclusie is dat de meerderheid van de deelnemende studenten een online wederkerig peer-begeleidingssysteem met behulp van IM positief beoordeelt. De resultaten zijn mogelijk wel beïnvloed door het feit dat ze werden gevonden in een setting binnen het reguliere onderwijs, waarbij studenten ook buiten het systeem om contact hadden met docenten en medestudenten tijdens bijvoorbeeld colleges. Hierdoor zijn mogelijk complexere vragen niet via het systeem gesteld

Als onderdeel van de tweede en derde vereiste werd in hoofdstuk 7 een empirische studie beschreven die werd uitgevoerd om in een setting waarin geen docent beschikbaar is na te gaan hoe de antwoordkwaliteit van peer-begeleiders is, hoe bereid studenten zijn elkaar te helpen en om na te gaan welke houding studenten hebben ten opzichte van online wederkerige peer-begeleiding. Het SAPS-systeem werd beschikbaar gesteld aan deelnemers van een online zelfstudiecursus. De meeste deelnemers waren tussen de 41 en 70 jaar oud. De volgende resultaten werden gevonden:

- Experts beoordelen het merendeel (57%) van de door peers gegeven antwoorden in een setting waarin geen docent beschikbaar is met een 4 of 5 op een 5-punts Likertschaal. Het merendeel van de antwoorden wordt daarom als voldoende beschouwd.
- Studenten beoordelen het merendeel (51%) van de door peers gegeven antwoorden in een setting waarin geen docent beschikbaar is met een 4 of 5 op een 5-punts Likertschaal. Het merendeel van de antwoorden wordt daarom als voldoende beschouwd.
- 29% Van de vragen van studenten blijven onbeantwoord, veel meer dan de verwachtte 10%. Echter, in veel gevallen betrof dit situaties waarin een verzoek wel door een peer was geaccepteerd, maar waar in de uiteindelijke chatsessie geen communicatie plaatsvond. De reden hiervoor is niet bekend, maar het heeft mogelijk te maken met de onbekendheid van studenten met IM of met technische problemen. Wanneer deze gevallen en de door tutees zelf geannuleerde verzoeken niet worden meegerekend, blijft 16% van de gestelde vragen onbeantwoord, een percentage veel dichter bij de veronderstelde 10%.
- Het percentage onbeantwoorde vragen bleef constant gedurende de cursusperiode.
- De meerderheid van de deelnemende studenten stond positief ten opzichte van online wederkerige peer-begeleiding. Het gebruik van IM voor dit doeleind wordt echter minder gewaardeerd, hetgeen te wijten zou kunnen zijn aan de onbekendheid van de deelnemers met het medium, aangezien de grootste groep deelnemers tussen de 41 en 70 jaar oud was.

Geconcludeerd kan worden dat online wederkerige peer-begeleiding via het SAPS-systeem een volwaardig alternatief docent-begeleiding is wanneer deze niet beschikbaar is, aangezien peer-begeleiders het merendeel van de vragen van medestudenten voldoende beantwoorden. Kritische factoren hierbij zijn wel de bereidheid van studenten om elkaar te helpen en de leeftijd van de deelnemers. Dit aangezien deze van invloed kunnen zijn geweest op hun houding ten aanzien van en hun vertrouwdheid met een systeem voor online wederkerige peer-begeleiding via IM, die mogelijk wordt weerspiegeld in de uitkomsten van de studie (zoals het hoge percentage onbeantwoorde vragen).

Wanneer de belangrijkste bevindingen in het licht van het kader van de requirements analyse worden bezien, kunnen uit het onderzoek de volgende conclusies worden getrokken.

1) Positieve houding van studenten ten opzichte van online wederkerige peer-begeleiding. Studenten hebben over het algemeen een positieve houding ten opzichte van online wederkerige peer-begeleiding. Onder jongere studenten biedt IM een geschikt medium voor het geven en verkrijgen van de begeleiding zelf, hun oudere medestudenten zijn minder enthousiast over en minder vertrouwd met het gebruik van IM voor dergelijke doeleinden.
2) Voldoende competente peers en duurzaamheid van het systeem. Het SAPS-systeem is gebleken in staat te zijn competente peers te selecteren voor het beantwoorden van vragen. Op het vlak van duurzaamheid van het systeem kan worden gesteld dat studenten bereid bleken te zijn om vragen van medestudenten te beantwoorden. Deze bereidheid kan echter problematisch zijn wanneer de studenten niet vertrouwd zijn met IM, omdat werd vastgesteld dat wanneer dit het geval was meer vragen onbeantwoord bleven.
3) Begeleiding van voldoende kwaliteit. De kwaliteit van de door peers gegeven antwoorden is over het algemeen voldoende gezien de context van het niet beschikbaar zijn van een docent. Peers zijn in staat het merendeel van de vragen van medestudenten bevredigend te beantwoorden. Bovendien verschillen de leerprestaties van door peers begeleide studenten niet significant van die van de door docenten begeleide studenten.

Heel in het algemeen laten de studies die in het kader van dit onderzoeksproject zijn uitgevoerd zien dat een online wederkerig peer-begeleidingssysteem een geschikt alternatief is voor ondersteuning door docenten in gevallen waarin die niet beschikbaar is.

List of publications

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Curriculum vitae

Gijs de Bakker was born on May 4th 1979 in Tilburg, the Netherlands. After pre-university education, he studied English Language and Culture at Utrecht University. After his graduation in 2003 he worked as a communication consultant. In 2006, he started as a PhD-student on educational technology at Fontys University of Applied Sciences (Fontys teacher training institute Tilburg) and the Eindhoven University of Technology (Eindhoven School of Education). Currently, he is working at the intranet department of Rabobank Nederland as a content manager.

Eindhoven School of Education

PhD dissertation series

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