Using Facebook to Improve Communication in Undergraduate Software Development Teams

Terence Charlton [a], Marie Devlin [a], Sarah Drummond [b]
[a] *School of Computing Science, Newcastle University, Newcastle, UK*
[b] *Department of Computer Science, Durham University, Durham, UK*

As part of the CETL ALiC initiative (Centre of Excellence in Teaching and Learning: Active Learning in Computing), undergraduate computing science students at Newcastle and Durham universities participate in a cross-site team software development project. To ensure we offer adequate resources to support this collaboration, we conducted an experience survey amongst teams and a content analysis of their reports. This paper reports on the findings of that investigation, and shows that success in the project was often determined by the students' communication strategies and use of available technology. Significantly, students often abandoned the technologies provided and adopted Web 2.0 technologies such as Facebook instead. Based on these findings we have developed a tool called CommonGround, designed to run on the Facebook platform, which harnesses the students' engagement with the service. CommonGround couples the communication and "social awareness" features inherent in the sFacebook platform with basic meeting, schedule and project planning facilities. Initial feedback from students using CommonGround is encouraging.

Keywords: cross-site software development, social networking, communication behaviour and tools

Introduction and Rationale

Active Learning in Computing (CETL-ALiC, 2005) is a five-year collaborative CETL project funded by the Higher Education Funding Council for England (HEFCE). As part of this work we run a year-long cross-site software development team project between Newcastle and Durham universities, targeting students taking our respective Level 2 Software Engineering (SE) modules. By extending our traditional computing group projects to include inter-institutional collaboration, we are better able to align our students' team-work activities to current work-based practices and, in doing so, prepare them for the realities of working in today's software engineering industry.

Many large software development companies increasingly rely on global software development; virtual teams that work across space, time and organisational boundaries to design and develop software products. This approach has been shown to have a number of benefits, including improvements in efficiency, time-to-market, access to specialised labour, and reduced costs (Last, 2003; Kommeren & Parviainen, 2007). From an educational perspective, the student collaboration activity described here goes some way to simulate this working practice. It aims not only to give students an insight into the real challenges faced by companies competing in a global market, but also for us, as educators, to provide and encourage students in the development of new skills to support this way of working (which is a vital accompaniment to their technical

repertoire). Students need to be very much aware that "communication and cooperation are an inherent part of the social process of Software Engineering" (Johnston & Miles, 2004). While most computing departments provide students with some experience of team working, the opportunity for them to adopt cross-site collaboration is rarely taken (Drummond & Devlin, 2006), despite research that indicates its significant educational benefits (e.g. Brereton, et al., 2000; Last, Mats, Almstrum, Erikson & Klein, 2000).

This paper will provide an overview of our cross-site student software development projects, which have been in operation between the two institutions for the past four years, and outlines the structure and type of projects undertaken, and the technology infrastructure provided. More significantly, data captured in the current academic year from content analysis and questionnaire are also discussed, which indicate that communications between local and cross-site teams cause the most problems for students. As our findings will also show, the technologies that have been provided to facilitate communication throughout the project have been met with mixed reaction from the student body, and as a result many teams have adopted technologies which they feel better suit their needs. From the data collected, Web 2.0 tools such as Facebook have appeared as the technologies of choice, and as such we have recognised the growing importance of social networking as a means to support communication and work collaboration. To that end, we have developed a tool called *CommonGround*, which runs on the Facebook platform, coupling the inherent communication and "social awareness" features of the service with basic meeting, schedule and project planning facilities. A description of the tool and pilot study of its use are reported in this paper.

Background: Company Structure and Projects

In the four years since 2005 that we have run the cross-site development project, 377 level 2 students have taken part. These students are enrolled on a number of computing programmes including single honours Computing Science, Software Engineering, Information Systems, and Natural Sciences, with the Software Engineering module being common to all. Each company must collaborate and communicate in order to develop and deliver a large piece of software at the end of the academic year. Projects differ from year to year and range from a supply chain logistics problem for a multi-national company, to a mobile graphing application capable of collecting positional information from GPS and Wi-Fi access points (for more detail on these projects see Devlin, Phillips & Marshall, 2007).

During the activity, 12 'companies' are formed, each comprising a team from both institutions, with team sizes normally between 4-6 in Durham and 6-7 in Newcastle. Membership of each local team is chosen by staff based mainly on the students' performance and achievement in programming classes during level 1. This is to ensure a fair distribution of programming skills throughout the teams, and to give each an even chance of delivering a good product. Students are required to self-manage all stages of the software development process, from encapsulating design requirements to creating and testing programs. They have one full academic year to complete the project and are given a set of deadlines spanning two semesters for their major deliverables. Assessment (including of the students' ability to work well as a team) takes place in a number of ways, including group presentations, documentation delivery (e.g. design documents), live demonstration of prototypes, observations during meetings, and the completion of individual reflective reports.

Technology Infrastructure

Supporting and encouraging cross-site collaboration between teams has involved the wide-scale use of a variety of communication technologies, ranging from video-conferencing facilities to simple email, forums and wikis (Devlin, Drummond & Hatch, 2008). Our choice of support technology was influenced mainly by industrial software engineering practices – where interactive systems often provide a human-centred approach to communication (Nevgi, Virtanen & Niemi, 2006) – and our desire to encourage students to remain in contact and aware of each others' activities. However, as Fussell, Kraut, Lerch, Scherlis, McNally and Cadiz (1998) point out, there is often a danger that the effort of communicating can sometimes be overwhelming, which we found to hold true in this case. As a result, most of the companies nominated a team member at each site to be a communication officer, whose task it was to ensure only relevant information filtered down to team members.

Other collaborative technologies provided were Skype, Subversion (an open-source version control system allowing students to share their code) and NESS (Newcastle Elearning Support System). NESS is a web-based Virtual Learning Environment (VLE) developed by Newcastle University that has been in use for a number of years. It allows students to submit coursework, receive feedback, contact staff, and to interact with one another via forums and shared document repositories. Students were also encouraged to investigate and use other communication and collaborative technologies as they saw fit, such as MSN, GoogleTalk, SMS, bulletin boards and mobile phones.

Communication Issues

Our understanding of the communication issues faced by students (over the many iterations of this project) is based mainly on information gathered through observation and focus groups. For this study, we divided the technology choices reported by students into three categories: *primary*, *secondary* and *sampled*. *Primary* refers to the communication technologies adopted by students as their main means of cross-site communication, *secondary* to technologies used as a 'back-up' in case their primary method failed or was unavailable, and *sampled* to the technologies tried by students but ultimately abandoned.

During the first year of the cross-site work (2005-2006), we mandated that video conferencing be used as the primary communication method between sites for all 12 participating companies. Unfortunately, our video conferencing suite was not ready at the start of the project and we experienced considerable teething troubles with the set-up of the technology. Therefore, as can be seen in Table 1, students resorted to using email as a primary source of communication – it was both familiar and reliable.

Table 1: Student use of technology for cross-site communication, 2005-2006

Collaboration Method	Degree of Adoption (companies=12)		
	Primary	*Secondary*	*Sampled*
Video Conferencing	2	6	12
Instant Messaging	0	1	2
Phone/Text	0	1	3
Email	8	4	12
Skype	0	0	0
Google Talk	0	0	0
Face-to-Face	0	1	3
NESS Repositories	12	12	12

For the following year (2006-2007) 12 companies once again participated, but for this iteration forums and data-repositories (for storing code and documents) were introduced and hosted on NESS. As can be seen in Table 2, six companies experimented with the forums for discussion but, over time, reverted to using email as their primary method of communication. Interestingly, all companies retained use of the repositories and reported they found this facility very useful for working together. Again, we mandated the use of video conferencing technology as the main contact method between sites, which students continued to use as illustrated in Table 2 (at this time both sites had dedicated, fully-operational video conferencing facilities). However, problems were again encountered with the reliability of the technology, and in the end only seven companies actually reported it as their primary mode of contact. Perhaps more significantly, two companies chose not to use video-conferencing at all, with one company relying on Instant Messaging as their primary cross-site communication method.

Table 2: Student use of technology for cross-site communication, 2006-2007

Collaboration Method	Degree of Adoption (companies =12)		
	Primary	*Secondary*	*Sampled*
Video Conferencing	7	3	12
NESS forums	0	0	6
Instant Messaging	1	3	6
Phone/Text	0	0	3
Email	4	6	12
Skype	0	0	4
Google Talk	0	0	7
Face-to-Face	0	0	6
NESS Repositories	12	12	12

In the third iteration of the project (2007-2008), 10 companies participated. To avoid the problems encountered in previous years, we opted not to mandate the use of video conferencing technology. Instead, we introduced and mandated the use of a company wiki for storage of all documents and official decisions made by companies (i.e. meeting agendas, minutes and actions). This was partially motivated for assessment purposes, but also to provide students with a central record of their decisions. As can be seen in Table 3, only six companies opted to make real use of the wikis, most of which reverted to the use of email as their main contact method. Significantly, five companies chose to use Facebook to communicate with their cross-site partners.

Table 3: Student use of technology for cross-site communication, 2007-2008

Collaboration Method	Degree of Adoption (companies =10)		
	Primary	*Secondary*	*Sampled*
Video Conferencing	1	0	8
Instant Messaging	1	6	7
Phone/Text	0	4	4
Email	7	3	10
Skype	0	5	5
Google Talk	0	0	7
Face-to-Face	1	2	8
Facebook	0	2	5
Wiki	0	6	10

Despite our efforts to support and encourage interaction between individuals and teams, students have continued to report significant problems communicating both locally and, to a much larger degree, cross-site (Devlin et al., 2007). Increasingly, we have noticed that teams find it hard to determine, even after discussions, what their cross-site partners are currently doing, what the current schedule or soft deadlines are, and who is implementing a certain software component. This confusion frequently leads to duplication of work and increased frustration for many team members. Whilst the technologies we have provided *do* play a role in supporting their collaboration, student experiences have shown there is still much room for improvement, especially in terms of project management and relationship building. Indeed, the value of social interaction cannot be underestimated when trying to build up trust and empathy between distributed teams (Layzell, Brereton & French, 2000).

Fortunately, the advent of Web 2.0 and its wider usage may provide a solution. Web 2.0 (O'Reilly, 2005) refers to a new generation of community-centred web services and applications that encourage openness and participation (e.g. blogs, wikis, social networking sites, RSS feeds, podcasts). Leading examples include Wikipedia, Flickr, Twitter, Delicious, YouTube, iTunes, and social networking services such as Facebook and MySpace, which place an emphasis on social interaction, content sharing and user-generated content and collaboration (Corfield, Green & Pearson, 2008). Recognising this potential, a number of universities have already started to incorporate Web 2.0 technologies into their teaching and learning. For example, the University of Leeds offers blogs and wikis to staff, the University of Warwick offers personal blogs to students, and the University of Brighton offers blogging via Elgg to 36000 users in the spirit of shared academic interest and social community (Franklin & van Harmelen, 2007). These technologies encourage users to establish and maintain relationships, to work together, to share thoughts and ideas, and in doing so create a "socially connected" web where anyone can contribute and share knowledge freely. It is these elements of social connection and community that are attractive to us as teaching practitioners, as they have the potential to help us improve student communication during cross-site work.

Social Networking and Facebook

Over recent years, social networking sites have witnessed a significant growth in popularity and membership (comScore, 2009; Acquisti & Gross, 2006). Since the release of SixDegrees.com in 1997, more popular (and far more successful) sites have appeared that allow users to represent themselves and their social networks online. Most start out as a variation on a theme – MySpace, for instance, connects people with similar social pursuits, LinkedIn connects people with similar business and employment interests, and Facebook connects people from similar educational backgrounds. Over time however, as users and developers evolve the services, many of these subtle variations have faded or even disappeared completely. Facebook, for instance, was initially restricted to academic communities, but in 2005 the developers removed this restriction and made the service available to everyone, stimulating unprecedented viral growth. In July 2009, the site announced it had surpassed 250 million active members (two thirds of whom are *not* currently in education), a trend which shows little sign of abating (Facebook, 2009).

Based on the concept of a US-style "year book", Facebook members create "profiles" to describe themselves (expository pages containing in-depth personal information, usually accompanied by a representative portrait picture). Rather uniquely to Facebook, members usually present their personal details openly and truthfully; for instance, they use their real names rather than pseudonyms or aliases. As reasoned by Grossman (2007), "identity is not a performance or a toy on Facebook; it is a fixed and orderly fact." Members are also able to articulate their social graph by connecting to other *known* profiles, or 'friends', mirroring their *offline* relationships *online* – an act also peculiar to the Facebook community (Lampe, Ellison & Steinfield, 2007). Indeed, by joining virtual 'networks' based on academic/business affiliations or geographic location, individuals are arguably better able to maintain (and perhaps strengthen) existing social ties (Haythornthwaite, 2002).

Facebook offers unparalleled access to the personal information and activities of friends and colleagues. Of particular interest to users is Facebook's ability to aggregate and summarise the actions of others – mainly friends – within the system (Burke, Marlow & Lento, 2009; Joinson, 2008). Initially attacked over privacy concerns (which are outside the scope of this paper), the service's 'news feed' allows members to *keep tabs* on their friends and their activities: who published photos and videos, who accessed what applications, who sent what message to whom, and who in turn commented back. More significantly, the ability to broadcast and share one's 'status' information – opinions, thoughts and activities – is also highly regarded by users, demonstrated not only on Facebook but also by the unprecedented success of Twitter (Joinson, 2008).

For many students, Facebook is an integral part of their daily routine; beyond micro-managing their social life, it offers an inherent capacity for generating social capital (Ellison, Steinfeld & Lampe, 2007). Students can interact with one another formally and informally (Kreijns, Kirschner & Jochems, 2002), build trust (Dwyer, Hiltz & Passerini, 2007), and extend their communication potential beyond the geographic confines of their institutions. As shown by Selwyn (2007), the service can also act as an important site for the informal, cultural learning of being a student, with online interactions allowing roles to be learnt, values understood and identities shaped. Indeed,

as the service pervades the business world more and more, Facebook represents a communication channel that can't be easily ignored.

Study Details

Based on these initial findings, we were very interested in incorporating Web 2.0 technologies into our cross-site project, to support and engage our students in their collaborative learning and communication. However, our view is similar to most other higher education providers, "pedagogy rather than technology should lead the learning experience" (Jones & Lau, 2009). It is necessary to get the 'blend' right between the uses of technology to enhance and support collaboration, and the pedagogical approaches that we use. We therefore decided to undertake a study of our students' communication and technology needs to investigate the potential impact and benefits of integrating Web 2.0 and emerging social networking technologies into the project.

First, in order to determine more precisely what the communication needs of our students were during the team project, we conducted a content analysis of team reports that were submitted during the project. The team report is an end-of-project review document that encourages students to reflect on how they have performed and what they have learned (under the headings communication, planning, requirements analysis, design, implementation, testing, team working and project management.), and to indicate to us possible ways to improve the project in the future. For this study, a total of 12 reports were analysed, one for each company taking part in the project during the 2008/09 academic year, to obtain the qualitative data presented. To encourage honesty and to avoid the problems of self-reporting, the team reports are given a minimal percentage of the teams' overall project mark (approximately 0.5%). There was no formal coding of the reports; instead, the *communication* section of each report was reviewed for instances of positive and negative experience with communication technologies, both between sites and at a local level. Instances were ordered in terms of preference, frequency of use and reliance upon the adopted technology, and then categorised into *primary*, *secondary* and *sampled* use (see Tables 1, 2 and 3).

Secondly, to form a picture of the students' overall communication behaviour, we conducted an experience survey to investigate in more detail the ways in which students make use of communication tools during the project, both locally and cross-site. Taking the form of a questionnaire, this survey also explores the students' opinions and current use of Facebook as a part of their overall communication strategy.

Team Report Results

The students' end-of-project team reports are assessed on a number of different criteria. In addition to demonstrating an appreciation of how their individual actions, roles and attitudes affect the project process, they are also assessed on their responses to problems and their understanding of the tasks required at each stage of the software engineering lifecycle. In particular, they are asked to describe their company communication strategy, how this strategy works in practice, and to detail any communication problems they may have had and the solutions they have implemented to resolve them.

Formal communication strategies:

Table 4: Company communication strategies

Team	Communication Technologies	Strategy for Cross-Site Communication
10	Skype, email, instant messaging, wiki, face-to-face	Communications officers; wiki for documents; email; buddy system
9	Skype, Wiki, email	Weekly Skype meetings; wiki for collation of work; email for updates
11	Skype, email	Skype meetings; company liaison officers; email for documents
12	Skype, email, wiki	Limit number of voice-call participants in weekly Skype meetings; email for interim updates; wiki for completed documents
8	Skype, face-to-face, email	Limit number of participants; strict rules for meeting behaviour; face-to-face meetings at key stages; email as a secondary mechanism
6	Email, Skype, wiki	2 email updates per week; wiki used as a storage area and for personal logs; communication sub-team
5	Forum, email	Limit number of participants at Skype meetings; use forum and email primarily; phone secondary; instant messaging for urgent problems.
1	Email, Skype	Frequent email updates; Skype meetings
2	Email, phone, instant messaging, Facebook, wiki	Email and phone; instant messaging and Facebook as secondary methods
3	Email, Skype, instant messaging, text, wiki	Communications officers on both sides
4	Email, instant messenger, wiki	Email all recent developments; store all task completion data on wiki; collate documents on wiki
7	Skype, Facebook, email, wiki	Face-to-face meeting at start of phase; sub-team meetings focusing on task

Communication strategies varied considerably in complexity between companies. For instance, one company decided at the outset to send only a designated number of group-wide emails per week (Table 4, company 6). Others formally defined the specific types of content allowed in their emails, and exactly how often they should be 'checked', as highlighted by the following comment:

> *"It was written into the Team Contract that members must check their e-mail nightly and must give notice if they cannot attend a meeting or complete a piece of work by its soft deadline. This system has worked well; nobody has been left wondering why people haven't turned up for meetings and everyone is made aware if any plans change."*

Other companies defined a more general operational protocol that outlined the order of precedence in which the technologies should be used (Table 4, companies 2, 9 and 12 for example). One company implemented a 'buddy system' (Table 4, company 10), whereby all team members were paired with a cross-site partner who would serve as their main contact for the duration of the project. Buddies were paired based on role similarity and responsibilities across sites.

Most companies established rules for behaviour in meetings, and specific weekdays for sending agendas and updating task completion lists. At the end of the project, despite the communication strategies in place, all twelve companies experienced difficulties in communicating both locally and across site, with cross-site communication often being cited as the most problematic aspect of the project.

Technology experiences:

All the companies used mobile phone and text messaging as a form of emergency contact during the project, but only one company (Table 4, company 3) made mobile phone usage part of their formal communication strategy. Most companies agreed informally on situations that merited a phone call or text message, and these included: being late for a meeting, notification of sickness or for quick questions to clarify aspects of the project. The majority of companies tried using Skype during the project, with 7 teams reporting it as one of their primary means of cross-site communication.

As discussed earlier, when we originally designed the project, we advocated student use of the video conferencing technology very strongly – encouraging the companies to use it as a primary means of communication between sites. The motivation for this, as stated earlier, was that video conferencing technology was recognised by many as a rich form of virtual interaction and was viewed as being a good solution to compensate for the lack of physical face-to-face meetings (G. Olson & J. Olson, 2000; Kirkman, Benson, Tesluk & Gibson, 2004). However, students quickly voted with their feet and proceeded to use other forms of technology, altering their initial communication policies part way through the project. For example, several of the companies reported that, in the early stages of the project, all their members had attempted to attend virtual cross-site meetings but their experiences with the limitations of Skype technology had made them rethink their meeting format and attendance patterns:

> *"While we found that some good progress was made with it, often only one or two people could speak at any one time. We decided for later meetings only those directly involved in the main agenda items should attend and report back to the rest of the team."*

Significantly, Table 4 shows communication strategies still predominantly featured the use of email as the primary cross-site communication method for all companies. All companies used the team email distribution lists issued by us for the project duration, and many reports stated that email was the most reliable and convenient method for disseminating documents and updating each other on project progress. Previous iterations of the project reflect a similar result (Devlin et al., 2007). Paradoxically, students' report that email – as a primary communication method – also hindered communication, especially when team members did not check their mailboxes on a regular basis, or when there was a delay in response:

> *"We have not been particularly efficient in communicating cross-site. Communication via email for the most part has taken 3-4 days to receive a reply from our cross-site team. This has been inefficient as decisions need to be made quickly."*

Other technologies also presented the same problems for students. One company, for example, elected to use a third-party forum – despite the availability of a forum on the VLE – as a major method of cross-site communication, but had less success than expected:

> *"The forum has up and coming work and meeting information on it and it also serves as a good place to keep in touch with one another's activities. However, it is true that the forum is sometimes under used. If it were used more often, it would eliminate a lot of avoidable issues which take up time in meetings."*

Interestingly, previous iterations of the project mandated the use of forums and discussion boards for cross-site communication, but students made very little use of them and so they were dropped for 2007/08. In place of these, we introduced Web 2.0 technologies in the form of wikis and retained them again for this current iteration, 2008/09. Unfortunately, as can be seen in Table 4, five companies elected to abandon the wiki completely as part of their formal communication strategy.

In general, all of the company reports showed that the technologies we provided presented some problems for the students. The communication strategies adopted by teams went some way to work around these failings, as did the students' efforts to persist with the technologies, but when they consistently failed to meet expectations they sought alternative strategies and tools. Also, students were unsure which technologies were the best to use and therefore they tried *all* of them, eventually settling on a reduced set. This is evident in the following student comment:

> *"With our cross-site counterparts obviously not being on the same site as us, we are required to use different forms of communication to contact them and it has not been going as well as we had hoped. From an outsider's view keeping up communications and maintaining good relations is simple as it only requires a video conference, and a few emails and meetings each week. In reality this was hard to maintain, especially across sites."*

Significantly, over the last two years, our students have become more familiar with freely available communication technologies that facilitate online interaction, and have started to incorporate these into the project (both to fulfil their particular group communication needs and mitigate the shortcomings of the technologies that we have provided). Facebook is perhaps the best example of this; it was not introduced into the project by us, but instead was something the students chose to adopt themselves. In previous years, its use was reported by a significant proportion of the companies, but only during meetings and presentations; rarely was it mentioned as part of their *formal* communication strategy (as shown in Tables 1, 2 and 3). Indeed, for the current iteration, only two companies noted it as part of their formal strategy (see Table 4), and four others reported that they had used it on an *informal* basis to "build team morale", "organise social events" or to "maintain the momentum of the project". And yet our survey results contradict this; as we will show, individual team members from each company have used Facebook for both informal and on-task interaction, but have simply not declared it in their reports (as though it would be unprofessional to do so).

Interestingly, these companies that report the use of Facebook in their formal communication strategies used the chat and message facilities as a *back up* for when there were delays in response to email, their primary method of communication. Even if someone does not answer their phone or read their email, companies felt certain that team members would eventually log into Facebook and would feel compelled to respond – almost as if resistance to Facebook was futile. Of particular note, unlike all the other technologies mentioned, Facebook received no negative comments in any of the team reports.

Survey Results

To form a better picture of the students' overall communication behaviour, and their attitudes towards using Facebook, we administered a questionnaire to further investigate their use of communication technologies during the project, both locally and cross-site.

Printed questionnaires were issued to all team members at Newcastle University during their closing team meetings, and an online version made available to their Durham University counterparts. In total there were 83 respondents; 72 male and 11 female. 61 of the respondents were from Newcastle and 22 were from Durham. From Newcastle all the respondents were undertaking our Information Systems or Computing Science degree and at Durham respondents were from Computer Science or Software Engineering degrees.

In the first part of the questionnaire we asked students general questions about their communications during the project, followed by more targeted questions regarding Facebook. We asked them whether they had ever used Facebook during the project – if they responded positively we then asked them to elaborate further and detail which features they had used. We also asked them to describe their friendship preferences and opinions on possibly using Facebook for the team project in the future. In particular, we wanted to find out if they were open to the idea of a custom application for Facebook that could support cross-site project communication and provide the functionality that companies used most during the project (i.e. chat, email, update and progress reporting). We report here on the findings from the questionnaire.

The majority of the respondents said they felt part of a 'community' with their team mates (86%), and that they felt their own personal communication ability was satisfactory, with 20% of students rating their ability as good, 25% rating it as very good, and 22% rating themselves as excellent. In response to where they felt communications might be breaking down within their company, surprisingly the majority of students blamed email – or rather the non-checking of email. For example, free-text responses included:

"Email, when people don't check it often enough"
"Poor rate of response from email, makes us feel like they are not bothering."
"It takes people a while to reply to emails."
"Lateness in responding to emails."

When asked how well they were able to keep track of task responsibilities, task completion or overall project progress, typical free-text responses included: "*We struggle.*." or "*…with great difficulty*" and of their cross-site counterparts " *They don't let us know what is happening*".

The questionnaire results also show that 98% of our survey participants possess a Facebook account, and regularly use the site to interact with friends, family and colleagues. The service is an integral part of their daily lives both on and off campus, and as reasoned by (Maloney, 2007), shows that students will invest considerable effort in building relationships around shared interests and knowledge communities. Indeed, without social interaction and a sense of trust and belonging, understanding and consensus between students is not likely to occur (Walther, 1996).

The questionnaire results also showed that Facebook was one of the students' preferred communication technologies for informal cross-site communication during the project. As can be seen in Table 5, students were asked if they had used Facebook during the project; 73% of respondents said yes to doing so locally, and 28% to doing so cross-site. The most popular Facebook functionality used by these students was chat, with 90% of respondents stating they had used this facility to interact with their team

mates locally and 72% cross-site. The next most popular facilities were messages (73% locally, 33% cross-site), discussion boards (47% locally, 37% cross-site) and wall-to-wall posts (50% locally, 18% cross-site).

Table 5: Project-related use of Facebook by students

Have you used Facebook to interact with your teammates?				
	Newcastle (N =61)		**Durham** (N =22)	
	Locally	*Cross site*	*Locally*	*Cross site*
Yes	45	17	16	6
Which features have you used on Facebook to interact with teammates?				
	Newcastle (N = 45)		**Durham** (N = 16)	
	Locally	*Cross site*	*Locally*	*Cross site*
Chat	39	25	15	14
Wall-to-wall posts	28	11	6	2
Status comments	10	3	4	0
Group discussion boards	20	19	8	5
Photo or video comments	5	1	0	0
Applications	6	4	0	0
Messages	35	18	11	4
Other	1	1	0	0

Interestingly, the most popular facilities used by students on Facebook are the same as, or at least comparable to, the technologies provided by us for the project, differing only by being located in one combined, readily accessible location. Indeed, these findings are backed up by a long standing body of research that establishes the importance of context and familiarity when people are confronted with new technologies. As shown by Kling (2000) and Orlikowski (1992), individuals need to invest significant time to understand and effectively interact with a new technology and, unless they form an appropriate understanding of the technology, may resist using it (or not integrate it properly into their work practices). Indeed, in our attempts to stimulate collaboration by introducing students to a variety of new communication methods (combined with the students' attempts to use all of them), it would appear we may have inadvertently contributed towards reducing it.

Furthermore, these findings also serve to highlight the potential strength of using the pre-existing and convenient collaborative affordances of Facebook. In our survey, the students' attitudes to Facebook were very positive in terms of team-building and team communication. As can be seen in Table 6, when asked if they thought Facebook encourages openness, 68% of the respondents said yes. In terms of developing relationships, 66% reported that they had sought to learn more about their company mates via their Facebook profile. These results are encouraging, especially considering the lack of cross-site face-to-face meetings which help to strengthen working relationships. If Facebook can help students achieve more familiarity with each other and establish an increased level of trust (60% of respondents said they thought Facebook did this), then the strengthened relationships would make communication easier. Importantly 84% of respondents said they would be comfortable interacting with teammates via Facebook.

Table 6: Attitudes towards Facebook

	Answered "Yes"
Do you think Facebook encourages you and your team mates to be more open with each other?	68%
Have you sought to learn more about your team mates via their Facebook profile?	66%
Do you think Facebook helps build trust with team mates?	60%
Would you be comfortable using Facebook to interact with your team mates?	84%
If our application contained a 'status' for all team members, would you prefer to keep it separate from your main Facebook profile status?	96%*

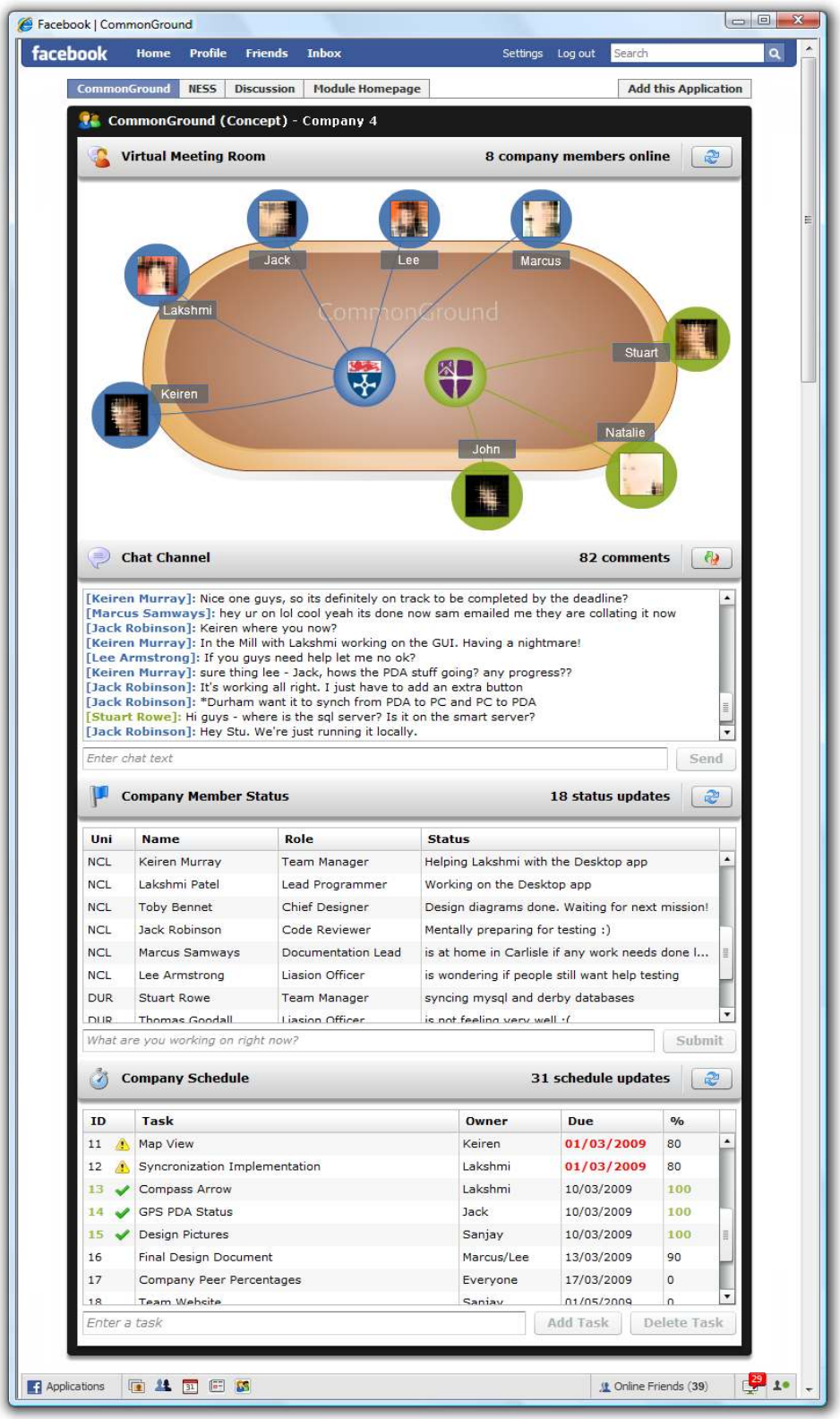
*Of note, students wished to make a clear division between their 'Facebook status', which is open to all of their friends, and their 'project status'.

Of note, students had reservations with regards to using Facebook for the purposes of the project. In particular, they were reluctant to be "forced" to add their team-mates as friends on the service (especially with respect to their cross-site colleagues with whom they were less acquainted). This was to be expected, however, given the informal nature and current recreational use of Facebook. Indeed, as the work of Postmes, Spears & Lea (1998) indicates, group members think, feel and behave according to the context in which they are communicating, and in each social setting they possess a separate "social identity" with differing behavioural norms and expectations. The students' initial reaction to our attempt to interfere with their social identity on Facebook is, therefore, entirely understandable, but overall the questionnaire results show that students were quite open to using Facebook as a means of communication during the project.

Creating a Common Ground

In an attempt to enhance the user experience and remain competitive, the majority of mainstream social networking services have opened their platforms to software developers. This allows third-party internet applications and web-based services to be seamlessly integrated into the site, taking advantage of the social connections of its users and extending the platforms' core functionalities. In particular, the release of the Facebook application framework has received notable media coverage and user uptake; as of July 2009 there are more than 175 million users of 350 thousand third-party applications on the platform (Facebook, 2009). Based on the results of our study and with this in mind, we have developed a proof-of-concept RIA (rich internet application) called *CommonGround*, designed to run on the Facebook platform (see Figure 1; in all illustrations profile images have been obscured and fictitious names used to maintain anonymity). Developed in Adobe Flex, the application provides a standards-based rich interactive experience to the user (Murugesan, 2007), utilising – and extending – the inherent communication and "social awareness" affordances of the Facebook service.

Figure 1: Common Ground Application



Employing the new Adobe Flash Collaboration Service, the application is able to offer a number of real-time social capabilities to the user: namely meeting, status awareness, and schedule planning facilities. Harnessing the students' familiarity and heavy use of the service, it is our intention to encourage better team interaction and

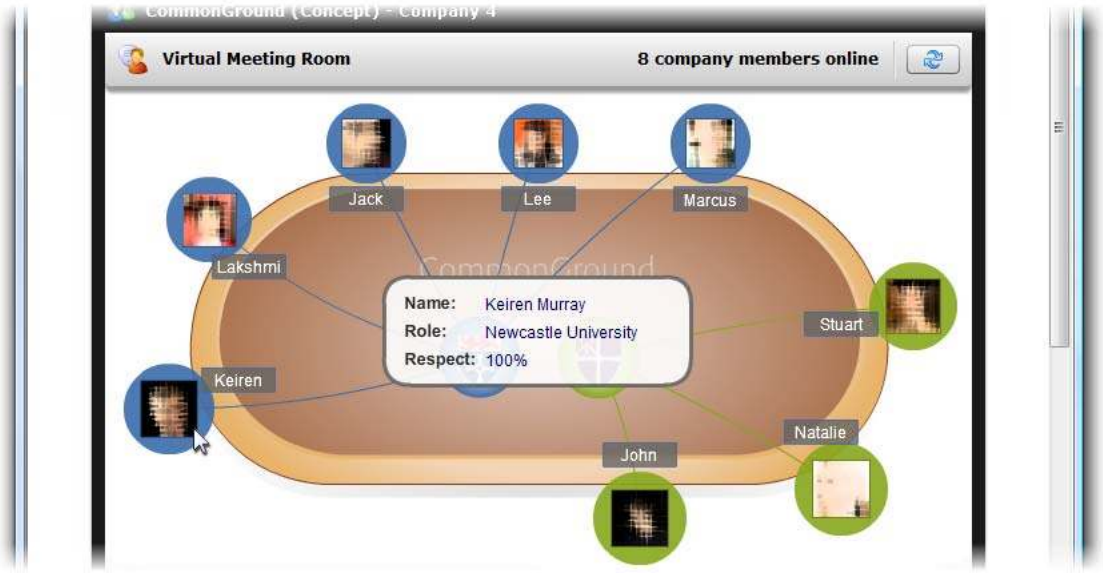
familiarity (via profile exploration and informal encounters), increased status awareness (via status updates), and greater project planning potential both locally and cross-site.

I'll Meet you on Facebook

In a collaborative educational context, *CommonGround* offers a means to foster group collaboration and community-building by providing a centralised application through which students can explore the personal profiles, statuses and work rhythms of their team mates. Research shows that social awareness and informal communication facilitate 'on-task' discussion and that many productive interactions in a teamworking environment occur during chance encounters (Kreijns et al. 2002).

To encourage such encounters in Facebook, and to enable a basic online awareness between students, we have created a "virtual meeting room" that displays presently connected users and their institutional affiliations. We have employed a "familiar" visual setting; one that is analogous to the students' real-world learning environment (i.e. an illustrated reproduction of a traditional face-to-face meeting room). Basic name and team-role details can be accessed by rolling over a teammate's profile image, as shown in Figure 2. Selecting a teammate's image opens their profile page, containing full account information for that person (including contact details). This helps put a face to the students' teammates (many of whom they may never meet in person).

Figure 2: Common Ground: Virtual Meetings



Privacy settings are respected by *CommonGround*, and private profiles are inaccessible. Of particular importance to users, teammates *do not* need to be 'friends' on Facebook in order to interact on *CommonGround*. Once a group account has been created, members can simply join that group in order to use the application. A simple chat facility is also available for synchronous discussion.

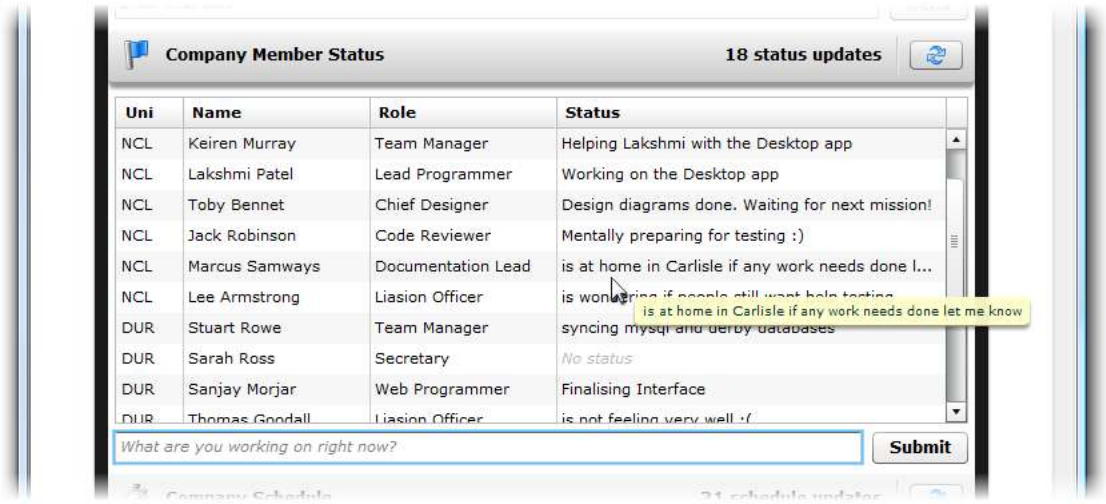
To encourage such encounters in Facebook, and to enable a basic online awareness between students, we have created a "virtual meeting room" that displays

presently connected users and their institutional affiliations. We have employed a "familiar" visual setting; one that is analogous to the students' real-world learning environment (i.e. an illustrated reproduction of a traditional face-to-face meeting room). Basic name and team-role details can be accessed by rolling over a teammate's profile image, as shown in Figure 2. Selecting a teammate's image opens their profile page, containing full account information for that person (including contact details). This helps put a face to the students' teammates (many of whom they may never meet in person).

Privacy settings are respected by *CommonGround*, and private profiles are inaccessible. Of particular importance to users, teammates *do not* need to be 'friends' on Facebook in order to interact on *CommonGround*. Once a group account has been created, members can simply join that group in order to use the application. A simple chat facility is also available for synchronous discussion.

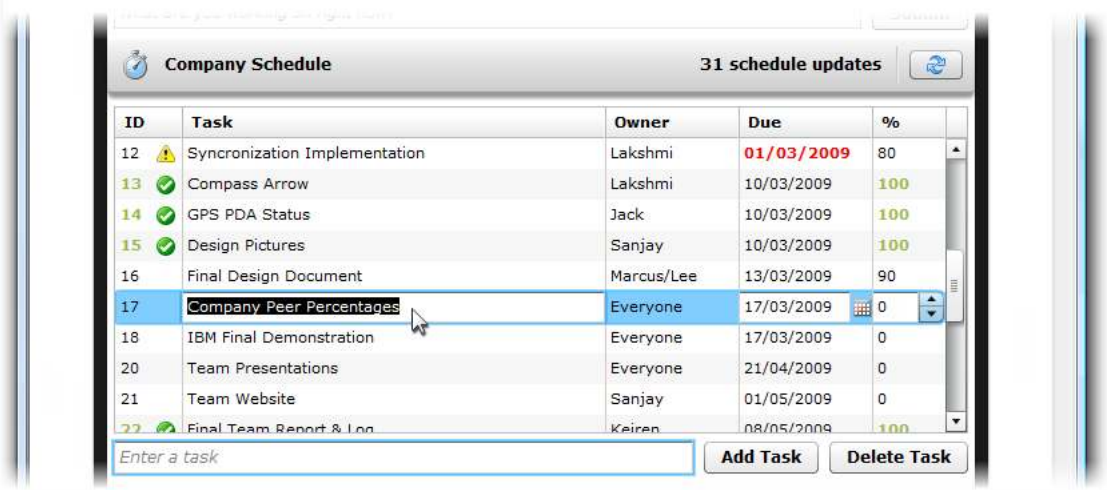
To promote status awareness between team members (i.e. what task each member is currently working on), a status facility *local* to the *CommonGround* application (and that team's group) is available (see Figure 3). In our study, it became apparent that students did not wish to have their Facebook status altered – the status that is available to their entire friend network – and so a separate, project-specific status list is maintained by the application.

Figure 3: Common Ground: Status Awareness



CommonGround also offers students a basic scheduling facility in order to provide a team-wide overview of project tasks, responsibilities, due dates and progress percentages (see Figure 4).

Figure 4: Common Ground: Company Scheduling



<Figure 4 here>

Pilot Study and Initial Findings

A preliminary pilot study of the *CommonGround* application is currently underway. Four companies volunteered to use the application – both locally and cross-site – during the implementation stage of the project, primarily to coordinate the difficult task of work allocation. Each team reported they had already used Facebook for communication socially with their teammates, but only locally. Data is still being collected as the project continues, but feedback from students thus far – obtained from interim interviews with team leaders and with teams as a whole during meetings – has been extremely encouraging, supported by activity logs which show positive, heavy use of the application.

Encouragingly, all students – when interviewed collectively – reported using *CommonGround* and Facebook as a "one-stop-shop" to contact and collaborate with team members. Synchronous communication tools and readily accessible personal information are being used to contact colleagues quickly, and 'one-to-many' asynchronous tools are utilised for less pressing matters. Perhaps more importantly, each student also reported a heightened level of social awareness whilst interacting online, indicating that they feel increasingly aware of each others' work patterns, status, progress-to-date and future allocated tasks. From a collaborative perspective, students believe that this increase in informal encounters has helped encourage team member connectedness and, significantly, 'on task' discussion.

These findings suggest that students have integrated CommonGround into their working practices with little resistance (in stark contrast to other communication technologies offered as part of the group project, which as described earlier often go ignored). Furthermore, the initial feedback from students suggests that the use of email as the dominant local and cross-site communication strategy has been supplanted somewhat by the use of the combined communication affordances of the CommonGround application and the built-in Facebook messaging facilities. Significantly, this finding is supported by reports of social networking message traffic

overtaking that of web-based email (Nielsen, 2009). Evidently, students no longer email but "Facebook" each other.

Surprisingly, students report that they felt much more inclined to communicate via Facebook once they realised "it is okay to do so". This suggests that students perhaps don't perceive social networking sites as an acceptable form of professional communication, despite awareness of large corporate networks on the service. Indeed, one team member commented:

> *"I thought Facebook was too informal to be a valid tool for use during work." Feedback now seems to indicate that this initial opinion was misplaced.*

As noted earlier, students voiced an initial concern regarding the nature of *CommonGround* and the scope of the application's status updates and profile exploration features on Facebook. They were particularly averse to being "forced" to add their cross-site team mates as friends on the service, and wished to keep their work and leisure activities separate. Fortunately, once they familiarised themselves with the "sandbox" nature of the application, this resistance was largely forgotten.

Discussion

Over the past four academic years we have gained significant insights on cross-site student team projects and the areas that cause most concern to the students. Some of these areas, such as assessment, have been able to improve year-on-year. However, communication issues have been problematic and, despite our best efforts, we have been unable to greatly improve cross-site interaction. We found that it was not only the information overload from project emails, which caused problems for the students, but also the overload of the variety of technologies which we had provided to support them. Students, however, voted with their feet and many adopted familiar social networking environments (i.e. Facebook) as one of their primary collaborative tools for both informal and on-task interaction.

Interestingly, results from this study have shown that some of the functionality provided by Facebook and *CommonGround* (such as messaging, chat and wall-to-wall posts), were already provided by us in other applications, but which the students chose, in many instances, not to use. Given that this functionality is now centralised, and the barriers to interaction and community formation reduced, we are seeing that team members have become increasingly aware of each others' skills, personalities, work rhythms and needs – both online and off – within a pre-existing, persistent, convenient infrastructure.

The *CommonGround* tool described in this work is a proof-of-concept application and, as such, has received limited use. However, the initial results and feedback from students regarding the application are both extremely encouraging. By creating a persistent environment that interacts with and leverages the power of existing social networking services, team members appear to be better able to maintain their interactive cohesiveness, team awareness and project planning potential beyond face-to-face meetings. It is our intention to further examine how social networks are formed and developed in this environment, and to evaluate the extent to which the added sociability, social awareness and planning facilities affect social capital and an individual's social

identity. To this end, a second, more comprehensive version of *CommonGround* is currently under development to be used throughout the life of the project in the next academic year.

References

Acquisti, A., & Gross, R. (2006). Imagined Communities: Awareness, Information Sharing, and Privacy on the Facebook. *6th Workshop on Privacy Enhancing Technologies, 4258*, 36–58.

Brereton, O.P., Lees, S., Bedson, R., Boldyreff, C., Drummond, S., Layzell,P., Macaulay, L.A., & Young, R. (2000). Student Group Working Across Universities: A Case Study in Software Engineering. *In Proceedings of the 13th Conference on Software Engineering Education & Training* (pp. 76–86).

Burke, M., Marlow, C., & Lento, T. (2009). Feed Me: Motivating Newcomer Contribution in Social Network Sites. *Proceedings of the 27th international conference on Human factors in computing systems* (pp. 945–954). ACM Press.

CETL ALiC. (2005). Centre for Excellence in Teaching and Learning: Active Learning in Computing: http://www.dur.ac.uk/alic.

comScore (2009). *Press Release: Facebook Ranks as Top Social Networking Site in the Majority of European Countries.* Retrieved 17.4.09 from http://www.comscore.com/press/release.asp?press=2774

Corfield, G., Green, S., & Pearson, E. (2008). Could PLEs be the future, from Institutional to Student Control? *Proceedings of 9th Annual Conference of the Subject Centre for Information and Computer Sciences* (pp. 140–146).

Devlin, M., Drummond, S., & Hatch, A. (2008). Using Collaborative Technology in CS Education to facilitate Cross-Site Software Development. *Journal of Systemics, Cybernetics and Informatics, 6*(6), 1–6.

Devlin, M., Phillips, C., & Marshall, L. (2007). Making Computing Science Students More Employable with Problem-Based Learning and Cross-Site Teamwork. *International Conference on Engineering Education and Research* (pp. 2–7).

Drummond, S., & Devlin, M. (2006). Software Engineering Students' Cross-site Collaboration: An Experience Report. *Proceedings of the 7th Annual Conference of the ICS HE Academy Conference* (pp. 95–100).

Dwyer, C., Hiltz, S.R., & Passerini, K. (2007). *Trust and privacy concern within social networking sites: A comparison of Facebook and MySpace.* Retrieved 14.07.09 from http://csis.pace.edu/~dwyer/research/DwyerAMCIS2007.pdf

Ellison, N. B., Steinfeld, C., & Lampe, C. (2007). The benefits of Facebook "Friends:" social capital and college students' use of online social network sites. *Journal of Computer-Mediated Communication, 12*(4), 1143–1168.

Facebook (2009). *Press Room: Statistics*. Retrieved 17.07.09 from http://www.facebook.com/press/info.php?statistics

Franklin, T., & van Harmelen, M. (2007). *Web 2.0 for Content for Learning and Teaching in Higher Education*. Retrieved 17.04.09 from http://www.jisc.ac.uk/publications/publications/web2andpolicyreport.aspx

Fussell, S.R., Kraut, R.E., Lerch, F.J., Scherlis, W.L., McNally, M.M., & Cadiz. J.J. (1998). Coordination, Overload and Team Performance: Effects of Team Communication Strategies. *Proceedings of the 1998 ACM conference on Computer supported cooperative work* (pp. 275–284).

Grossman, L. (2007). *Why Facebook is the Future*. Retrieved 17.04.09 from http://www.time.com/time/magazine/article/0,9171,1655722,00.html

Haythornthwaite, C. (2002). Strong, weak, and latent ties and the impact of new media. *The Information Society*, *18*(5), 385–401.

Johnston, L., & Miles, L. (2004). Assessing contributions to group assignments. *Assessment & Evaluation in Higher Education, 29*(6), 751–768.

Joinson, A.N. (2008). Looking at, looking up or keeping up with people: motives and use of Facebook. *Proceedings of Conference on Human Factors in Computing Systems* (pp. 1027–1036). ACM Press.

Jones, N., & Lau, A. (2009). Elearning: A Change Agent for Education. *Applied Research in Higher Education, 1*(1), 39–48.

Kirkman, B.L., Benson, R., Tesluk, P.E., & Gibson, C.B. (2004). The Impact of Team Empowerment on Virtual Team Performance: The Moderating Role of Face-to-Face Interaction. *Academy of Management Journa*l, *47*(2), 1–18.

Kling, R. (2000). Learning about information technologies and social change: The contribution of social informatics. *The Information Societ,y 16*(3), 217–232.

Kommeren, R., & Parviainen, P. (2007). Philips experiences in global distributed software development. *Empirical Software Engineering, 12*(6), 647–660.

Kreijns, K., Kirschner, P., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Educational Technology & Society, 5*(1), 8–22.

Lampe, C., Ellison, N., & Steinfield, C. (2007). A familiar face(book): profile elements as signals in an online social network. *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 435–444). ACM Press.

Last, M.Z. (2003). Understanding the group development process in global software teams. *Proceedings of 33rd ASEE/IEEE Frontiers in Education Conference, 3, S1F*.

Last, M.Z., Mats, D., Almstrum, V.L., Erikson, C., & Klein, B. (2000). An international student/faculty collaboration: the Runestone project. *SIGCSE Bulletin, 32*(3), 128–131.

Layzell, P., Brereton, O.P. & French, A., (2000). Supporting Collaboration in Distributed Software Engineering Teams. *Seventh Asia-Pacific Software Engineering Conference* (pp. 38–45).

Maloney, E. (2007). What Web 2.0 can teach us about learning. *The Chronicle of Higher Education, 53*(18), B26–27.

Murugesan, S. (2007). Understanding Web 2.0. *IT Professional*, *9*(4), 34–41.

Nevgi, A., Virtanen, P., & Niemi, H. (2006). Supporting students to develop collaborative learning skills in technology-based environments. *British Journal of Educational Technology, 37*(6), 937–947.

Nielsen. (2009) *Global Faces and Networked Places: A Nielsen report on Social Networking's New Global Footprint.* Retrieved 17.04.09 from http://blog.nielsen.com/nielsenwire/wp-content/uploads/2009/03/nielsen_globalfaces_mar09.pdf.

O'Reilly, T. (2005). *What is web 2.0. Design patterns and business models for the next generation of software.* Retrieved 17.04.09 from http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

Olson, G., & Olson, J. (2000). Distance matters. *Human Computer Interaction*, *15*(2) 139–178.

Orlikowski, W.J. (1992). Learning from Notes: Organizational issues in groupware implementation. *Proceedings of the 1992 ACM conference on Computer-supported cooperative work* (pp. 362–369).

Postmes, T., Spears, R., & Lea, M. (1998). Breaching or building social boundaries. *Communication Research, 25*(6), 689–715.

Selwyn, N. (2007). *Web 2.0 applications as alternative environments for informal learning – a critical review.* Paper presented at the OCEDKERIS expert meeting: alternative learning environments in practice: using ICT to change impact and outcomes.

Walther, J.B. (1996). Computer-Mediated Communication: Impersonal, Interpersonal, and Hyperpersonal Interaction. *Communication Research*, *23*(1), 3–43.