Communication and Collaboration Gaps among PhD Students and ICT as a Way Forward: Results from a Study in Sweden

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Abstract: The low completion rate and slow progress in PhD education have been highlighted in many studies. Universities attempt to improve the quality in their PhD education programs. However, the interaction problems and communication gaps that PhD students encounter make this attempt even more challenging. The aim of this study is to investigate the peer interaction problems and Information and Communication Technology (ICT) based solutions from PhD students' perspectives. The data collection method was an online open questionnaire (survey) and in-depth interviews were used to follow up. The target group for the survey was the PhD students at the Department of Computer and Systems Sciences at Stockholm University (N=90). The total number of respondents for the survey was 53 PhD students (59% response rate) and eleven randomly selected PhD students for the interviews. The sampling method for the interviews (n=11 and N=90) used different strata to get respondents who represented the great variety of PhD students in the programs. The data analysis was done with the help of SPSS (Statistical Package for the Social Sciences) and data mining (by the use of text mining). The results reflected a lack of peer interaction as an important issue in the perspective of the students. Based on this, a set of suggestions were discussed and the study showed several ICT solutions that have the potential to reduce the interaction problems and thereby improve the quality of PhD students' collaborative learning and research.

Introduction

In higher education, there is a need for promoting and practicing collaboration and focusing on social and pedagogical sustainability and peer communication. As discussed by (Moore J. , 2005) and (Aghaee & Hansson, 2013), there is a need for the academic community to create shared space for reflection and pedagogical transformation and hence peer communication is a part of the recommendations for enhancing the sustainability of education. The PhD Completion project (Ph.D. Completion Project, 2008) have shown several promising practices of useful peer collaboration and communication among PhD students, including initiatives to bring students together across disciplines for academic and social interaction, encourage study related community building activities, involvement of students in committees to promote their career development and networking, development of students groups, inter disciplinary collaboration, monitoring and evaluation of the student progress, developing network of support; e.g., facilitated blogging systems to improve communication and periodical support groups for minority and needy students, etc. Several other studies such as (Aghaee & Hansson, 2013; Boud, Cohen, & Sampson, 2014; Moore M. , 1989; Bienkowska & Klofsten, 2012) also pointed out the importance of collaboration and communication for achieving high quality PhD education.

In this digital era many of the collaboration forms can be enhanced or supported by the use of ICT (Aghaee & Hansson, 2013). As mentioned by (Hansson, 2014), the ICT umbrella (illustrated in Fig. 1) is so wide that it can cover different types of communication.

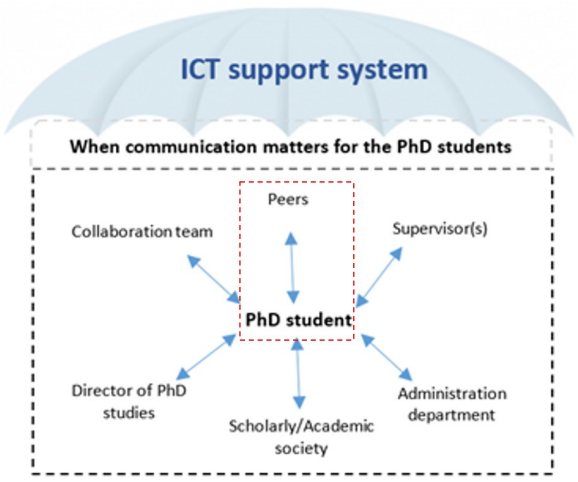

Figure 1**:** *A developed framework to reflect on the PhD students' communication and collaboration (inspired by discussion in Hansson, 2014 and Aghaee et al., under review)*

Nowadays most of the universities use ICT support systems for student and course management. Many of these systems include facilities for collaboration among peers enrolled in the same course. However, collaboration and communication needs for research at the PhD level is much higher than that can normally be offered by the peer communication facility provided by a learning management system. Typical scholarly systems such as ResearchGate®, and indexing supports such as Google Scholar® are useful for the PhD students in finding relevant literature and corresponding authors, but these systems are mainly serving the purpose of networking and efficient search of scholarly articles, allowing the researchers and their completed works be visible. Albeit, PhD students also need intimate support during the process of their research work, in addition to the support for communication of the research outcomes.

Despite that universities acknowledge the importance of peer communication and collaboration and constantly encouraging collaborative researches and other activities, insufficient peer communication is still identified as a problem that hinders the quality of the PhD education (Guilford, 2001). Further, support from peers is deemed as vital for learning and emotional support (Broome, Halstead, Pesut, Rawl, & Boland, 2011). The purpose of this research is to investigate and monitor the demands of peer interaction. Thereby, this study explores and reflects on what entails peer communication and collaboration among PhD students, and how an ICT support system can facilitate communication and collaboration in the perspective of the PhD students. Hence, the following research question was developed: What are the PhD students' needs and desires for peer communication and collaborative learning, and how can these be supported with ICT?

The rest of this paper is organized as follows. In the next section, collaborative learning, peer communication and online communities are further explored. This is followed by methodological considerations and application. The results and analysis are then presented, followed by the discussion in the consecutive sections. Finally, conclusions are presented.

Background

As discussed and shown by (Topping, 1998), there is adequate reliability and validity in the peer assessment process in different contexts and applications, such as writing and using marks, grades, and tests. Peer assessment has shown positive formative effects on student achievements and attitudes, which were even better than the effects of teachers' assessments (Topping, 1998). The influence of peer interaction in terms of growing learning outcomes and understanding is an important issue in higher education (Boud, Cohen, & Sampson, 2014). Important general organizational factors for successful implementation of peer assessments discussed by (Topping, 1998) are: to clarify expectations, objectives and acceptability, match participants and arrange contact, develop and clarify assessment criteria, provide quality training, specify activities, monitor the process and coach, moderate reliability and validity, and evaluate and provide feedback.

With respect to PhD studies, one of the commonly identified factors for dropouts is insufficient interaction and integration in the academic life and the lack of contact with other PhD students (Kyvik & Olsen, 2013; Ph.D. Completion Project, 2008). As (Kyvik & Olsen, 2013) discussed, many studies found that numerous PhD students struggle with a lack of communication with peer students and the staff. One of the most common reasons for PhD students' isolation is when the student is structurally isolated from peers and faculty because of programmatic features (Golde, 2005). This can be the case when the student is working in a small lab

environment or conducting fieldwork where there are few peers or faculty members accompanying and supporting the student. Bringing students together despite physical isolation becomes a challenge.

Peer interaction can also be regarded from a community perspective. A community, such as an educational community, is a place or space for people who share the same interests. The Internet has made it possible to participate in communities regardless of time and place. At the same time, communities should be able to support a sense of togetherness among their members. They can be regarded as social networks to be used for empathetic or social support, information sharing, and problem solving (Andrews, 2002; Preece, 2000).

Communities of practice refer to the community being a ground for development of common behaviors and practices in groups. As newcomers in a community, we normally do our best to fit in to learn according to the community standard (Wenger, 1998; Wenger, 2004). To participate in a community is important since this signifies belonging to a social system. Online communities can include both strong and weak tie relations, where the strong ties are characterized by frequent communication, access to similar information, shared values and social and emotional support, and where the weak ties are needed to expose the community to different ideas and approaches (Haythornthwaite, 2007). Both strong and weak tie relations are important for learning in online communities; while the former can help community participants develop deep knowledge within certain community boundaries, the latter supports development of new types of understanding and approaches, such as when people from different disciplines get together.

Differences found between supportive and non-supportive student communities have been related to the way community members have conversations. The results of a comparative study of a group that was recognized as unsupportive and one that was supportive has shown that the level of arguments in the unsupportive group was about a third of the more balanced and supportive group (Soller, 2001). In addition, there were much fewer questions posted in the unsupportive group, and these also remained unanswered by the other members. This shows that interaction among group members plays an important role.

Methodology

The PhD thesis process differs across countries or even universities. Hence, when investigating the communication and collaboration needs of the PhD students, one should either consider the PhD studies in general, or, pick up a case and conduct a deep investigation of the students' perceptions in the selected case. We have followed the latter, i.e., investigation of what are the PhD students' needs and desires for peer communication and collaborative learning, and how these can be supported with ICT with respect to a selected case. Accordingly, the focus is on collaborative learning among peers in the PhD programs at the Department of Computer and Systems Sciences (DSV) at Stockholm University (SU), Sweden.

As in many universities worldwide, at the department DSV at SU, the online communication among peers in PhD programs is mainly via email. All PhD students have individual study plans in which they schedule when to take courses, conduct research studies, write scientific articles, and so on. They work in different research projects together with researchers, and sometimes other PhD students both inside and outside of the department. Some are doing field studies in Sweden, others abroad. DSV has different ways to conduct PhD studies, including, full time research studies, and research studies combined with some percentage of teaching or tutoring. Industrial PhDs conduct research as a part of their regular work. In the current setup, the PhD students communicate their research work during the regular meeting in their research units. It is a guiding rule that the PhD students at DSV to publish in international journals. The common practice is that the students publish together with their supervisors. As stated in the preceding section, we explore the perceptions of the PhD students at DSV, about the adequacy of the communication channels and the support provided for communication and collaboration.

This research follows a mixed methods approach. Mixed methods provide a combination of conventional research strategies by deliberately combining methods from different traditions with different fundamental assumptions (Denscombe, 2010). A mixed methods methodology consists of three primary aspects: the use of qualitative and quantitative approaches in the same research project, explicit focus on the link between approaches (triangulation), and a pragmatic emphasis on practical approaches to research problems (Denscombe, 2010). As according to (Creswell, 2003), this was a concurrent procedure of mixed methods where both qualitative and quantitative data were collected to integrate the information in the interpretation of the results. This provided a means to corroborate the different results.

Data collection was based on open online questionnaire, followed by in-depth interviews. The questionnaire constituted three parts, namely, personal information, the students' perceptions of the communication and collaboration as a practical problem in their studies, and how ICT can be used to solve the problem. The questionnaire contained both closed- and open-ended questions. The closed-ended questions represented the quantitative component, and the numerical percentages and calculations were made using the SPSS analytical software. The open-ended questions represented part of the qualitative study and was analysed manually. Text mining methods are used to create a word cloud to monitor the most frequently used words in the responses

from the open questions. The online questionnaire was in English and distributed to the PhD students at DSV, in November 2013, by the use of university email. Further analyses of the outcomes from the questionnaire were carried out with in-depth interviews of a number of randomly selected PhD students. The sampling was maximum variation in order to interview a diverse group of PhD students and identify important common patterns from any group of PhD students (Miles & Huberman, 1994). The in-depth interview was also in English and conducted with a sample of the PhD students at DSV in November 2014.

The participants were informed about the purpose of the study by an introduction at the beginning of the questionnaire, interviews, and even in the emails. The data collection was completely anonymous and the participants were informed about the anonymity. For the survey study, two reminders with a time interval of one month (discussed by (Lemon, 2007; Dillman, 1978)) were sent, which increased the overall response rate by 10%. No rewards were given to the PhD students to participate in this study, no private information was used or connected to any respondent, and the background questions were totally optional. Two junior PhD students and two senior researchers at the department tested both the questionnaire and interview questions before distribution. Due to the descriptive nature of the study design, there was no possibility of statistical pooling for the questionnaire. The findings were thus presented in a narrative summary with some quotations from the respondents.

In analyzing the responses to the open ended questions, we used statistical data mining techniques such as frequency Cloud, word associations, and word correlations to visualize the overall idea of the message students try to express via the detailed answers. Such methods allowed aggregating individual ideas into clusters of different opinions, thereby making it easier to visualize the degree of expressed opinions to the measure of interest.

For interviews, eleven PhD students were randomly selected from different strata with respect to their age (less than or greater than 30), gender (male, female), the phase of the studies (full-time, part-time), and the number of years spent as a PhD student (less than 2 years, between 2 to 4 years, greater than 4 years). The interview questions constituted of the importance of communication and collaboration in their environment, how to improve it, and how and in which ways ICT can facilitate for the improvement. The interviews were analyzed qualitatively in a manual fashion to identify the points raised by the students with respect to communication and collaboration concerns in their PhD studies.

Results and Analysis

The response rate of the survey was 59% (53 out of 90) of the PhD students at DSV at Stockholm University. Based on the survey results, insufficient peer communication in the PhD programs was an important issue among the PhD students. Based on the closed questions of the survey, 70% of the PhD students deemed the lack of peer communication as a problem, which they considered as the second biggest problem after the lack of structured information in the PhD programs. Approximately 81% of the PhD students believed online access to a forum for peer communications or sharing ideas through a portal, e.g., to discuss about questions, problems, research ideas, etc., would be very useful to facilitate peer communication and collaboration.

Based on the open questions and the interview responses, most of the respondents mentioned that there is a lack of opportunity for collaborative research and scientific writing in groups of peers. They especially pointed out the unavailability of online tools for a/synchronous communications, such as chat, discussion forums, and sharing ideas through a portal as a problem. As mentioned by one of the respondents “more peer communication would definitely add some values to the PhD thesis process”. Another respondent highlighted the need to enhance communication in general, not only online but also face-to-face (f2f): “Peer communication online is only one type, f2f and real-world group and peer to peer communication is more substantial and somewhat lacking in the current setup”. In many instances the PhD students has to deal with their study difficulties on their own, and there is no formal way for the junior PhD students to partake of in order to benefit from the senior PhD students’ knowledge and experience.

A suggestion by almost all the respondents (both in the open questions of the questionnaire and the interview) was to develop a simple, efficient and practical ground support system to alleviate the peer communication gap. Developing a support system provides opportunities for better communication for all the relevant parties, e.g. supervisors, peers, administrators, etc. Another suggestion was about the concern for continuous online discussion on ethical issues, and how peer communication needed to be complemented by conversations with the more experienced supervisors and peers: “As senior researchers are instrumental in creating the day-to-day environment for proper dissemination of ethical standards and conduct, I think it would be good to also include some kind of communication tool for such issues.” Such a system could facilitate better interaction, communication and even collaboration among peers.

Based on the results, most of the PhD students believed that peer communication and collaboration was an important issue, which was heavily lacking in the PhD programs at DSV. There was a request for better support

for peer communications and collaboration. As mentioned by the respondents, supporting peer communication and collaboration through facilitating access to a specifically designed communication channel might positively influence the result of the PhD studies and the stress level of the PhD students. Better communication channels could facilitate peer interaction and add value to the collaborative learning.

The results from statistical text mining on open questions of the questionnaire showed that there were several important words the respondents used in describing the problems they had and the solutions they proposed, in order to enhance information acquisition, communication and collaboration among peers, and better interaction with the supervisors. We used the measures of term frequency on the open-ended responses of the questionnaire to visualize the most frequently used words in responding to the questions, and the result is shown in Figure 2.

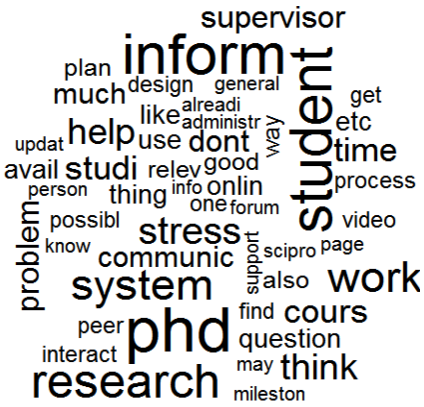

Figure *2*: *Word cloud of the most frequently used words*

The associations of the most frequently used words in the texts with other words are studied in order to understand the context of the frequently appearing words. Accordingly, the word "communication" is associated with peer, guide, heavy, real world, substantial etc., "stress" with reduce, and "peer" with guide, heavy, real world, substantial, communication, and ask. Although the amount of the available text in the responses was inadequate to perform a thorough analysis to capture the true essence of the discussions, these results provided some crude idea about what they were trying to express in their discussions.

The results of the interviews provided a deeper understanding of the PhD students' perspectives on where the communication gaps were. Moreover, the result of the interviews reflected the same result as the survey, on how PhD students feel about these communication and collaboration gaps and the ways of filling them by the use of ICT. All interviewees believed that there is a distinct lack of communication among peers. Furthermore, they acknowledged that peer communication is an essential and integral part of a high quality PhD research environment. In many cases, despite face-to-face meetings and seminars with the supervisors and other members of the units, the PhD students felt isolated and helpless when they needed peer support. Most of the interviewees mentioned that they had encountered difficulties in obtaining relevant information on time, for instance about the courses, conferences, publication opportunities, etc., due to the lack of a connection with their peer students.

Moreover, lack of peer communication limits identifying possible collaboration with peers of similar interests, thereby limiting the opportunities for delivering research results of better quality. For the lack of peer communication, the interviewees mentioned different reasons such as inadequate introduction of the new PhD students into the PhD community, lack of appropriate platforms to know and communicate with each other, and no structured information about the PhD community. It was therefore hard to remember peers when only meeting them in the corridor, and not having the mindset and culture of communicating and collaborating with each other unless it was required for some reason. A few PhD students mentioned that they limited collaboration themselves due to the time and language restrictions and/or cultural diversities.

Discussion

An ICT system to support peer communication and collaboration in PhD education has to be adjusted to the specific contextual conditions and requirements. One specific condition in a PhD education is that the students have their own individual study plans, and they conduct research and write scientific articles according to these plans. Sometimes they work together with other PhD students at the department, but often they work in projects with other researchers inside or outside the department. At the same time, in parallel with their projects, the PhD

students have reflected that they would like to interact and collaborate more with their fellow students. Online PhD communities could enable the students to get to know each other better and to establish a culture of peer support and collaborative learning among the PhD students. Such a system could facilitate informal communication and enable PhD students to get to know each other and find similar interests and areas of work to start collaboration. It is also reasonable to think that an ICT system could also facilitate introducing fresh students to the PhD community and to the learning environment for PhD students at the department. This system could support students to get introductory information on obligations and rights, including being able to have a mentor, who can be a senior PhD student as a guide. Frequently asked questions could be archived in an online repository, with functionality to vote for important questions.

As many interviewees mentioned, student profile pages, not only with their publications, but also with PhD students' research interests could be helpful to find peers with the same research interests. Peer communication facilitates obtaining information related to the rules, regulations, rights and limits as well as subject related information such as courses, student work groups, workshops, etc. Establishing the culture of using online services for scientific discussions allows PhD students to join the discussions whenever they have time or interest to join and exchange ideas. This helps enhance the awareness of the new trends and interests of the subject and thereby may improve the quality of research. Message boards and chat rooms as well as achieved success stories and experiences of the alumni not only add value to social perspectives of collaboration, but also provide opportunities to get inspiration from peers. These features will also form grounds for establishing more face-to-face communication.

In summary, the following figure (Fig. 3) illustrates the features and functions that the PhD students wish to have in an online system that could support student communication and collaboration needs.

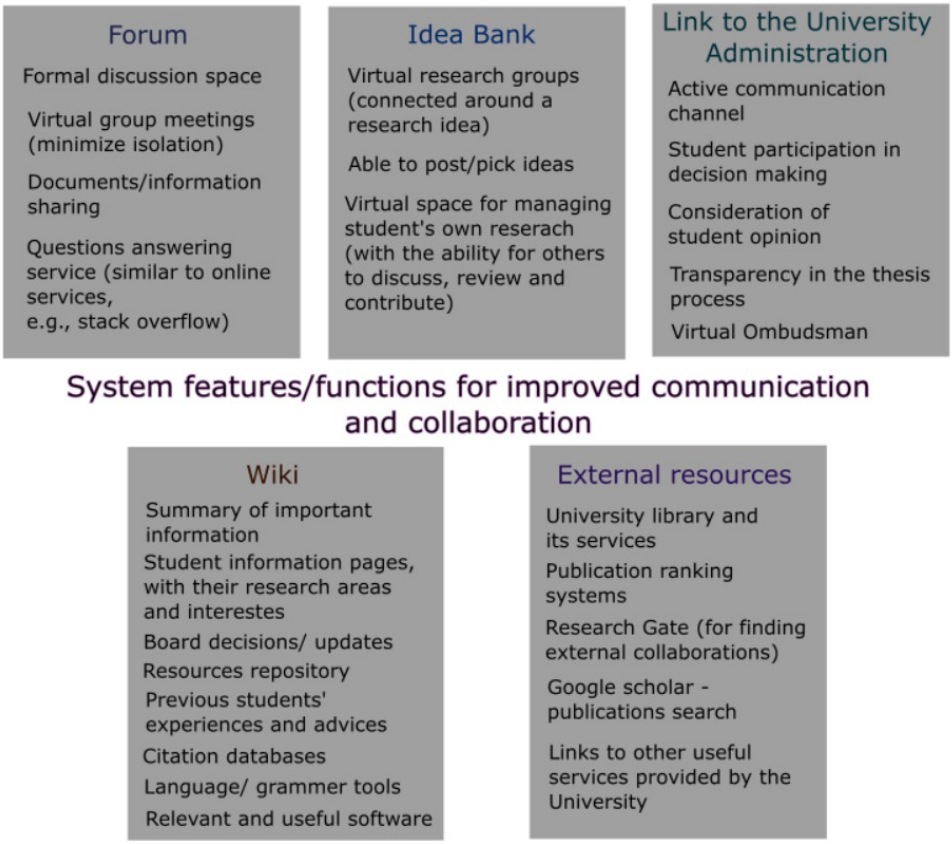

Figure 3: *The ideal online communication and collaboration support system in the perspectives of the PhD students at DSV*

Concluding remarks

Communication and collaboration gaps in PhD studies are being raised in many occasions, despite such facilities are prioritized by the universities. Identifying peer interaction problems in the PhD education and investigating how and in which ways ICT could be useful to enhance peer communication and collaboration was

the main purpose of this study. The strategy was to pick up a case, i.e. Department of Computer and Systems Sciences, Stockholm University, Sweden and investigate the student's perspective of the interaction, using a survey followed by in-depth interviews. From the results, online communication among peers was shown to be important, if such a system is developed accounting the PhD students' requirements and needs. One main concern of the PhD students was to have online peer interaction facility as a complement to the face-to-face communication.

The result of the study includes a suggestion to develop a simple, efficient, and practical ICT support system to facilitate peer interaction. Based on the framework and findings of the study, developing an ICT support system can be an umbrella to support PhD students' communication to obtain information related to the rules, regulations, rights and limits as well as the subject related information such as courses, student work groups, workshops, etc. Moreover, using online services for establishing collaboration and collaborative learning could allow PhD students to have stronger connections, join the discussions, exchange ideas, and enhance the quality of their research even when they are not physically present in the same geographical place.

The outcome of this study was a set of features and functions the students wish to have in an ICT support system for PhD studies in the department. Additionally, as many students mentioned in the interview, any supportive online system should be flexible enough to preserve the independent nature of the PhD studies, yet be efficient for establishing the interaction and obtaining required information whenever the needs arise, i.e., the system should be useful enough to reduce the student's feeling of being isolated in his or her studies. However, establishing a culture of students being online and supporting their peers by interacting and answering the questions may be a challenge and a process that require considerable time and effort.

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