Blended Supervision for Thesis Projects in Higher Education: A Case Study

Thashmee Karunaratne
Department of Computer and Systems Sciences, Stockholm University, Kista, Sweden
thasmee@dsv.su.se

Abstract: The thesis component of a degree program is vital since the quality of it contributes to the quality of the whole degree. Maintaining the quality of the degree programs and handling the constantly increasing numbers of students entering higher education simultaneously is a challenge for many higher educational institutions. This paper presents a study of how ICT can be used to improve the quality and effectiveness of the thesis projects at Bachelors and Masters Levels. Further, how the blended model of supervision supports solving the issues of managing supervisor time efficiently and providing a quality guidance for thesis students are also explored. Supervisors' perceptions of the ICT enabled thesis process are captured via interviews. Statistics about the completed theses and the user log data of the ICT system are triangulated to complement supervisor perceptions. Results revealed that the supervisors take advantage of the functions in the system to support improving the quality and the quantity of the theses, and the blended supervision model adapted in the thesis process support the supervisors to have a better collaboration with the students.

Keywords: Thesis, higher education, blended supervision, quality improvement

1. Introduction

In higher education, completing a thesis project is compulsory or preferred by any degree program, since it reflects analytical skills, decision making, organizing and delivery of innovative content. However, for many students, the path to success of thesis work is quite a lonely and tiresome task. Irrespective of whether on campus or distance, thesis work is a very much isolated and individual activity compared to the other courses in the degree program (Aghaee, 2015). Many students never complete their thesis works. From those who complete, only a few students manage to finish within the stipulated period and achieve a thesis of good quality. By 2008, the problem of low quality of the completed Bachelor's and Master's theses and the number of thesis attrition (dropout) was identified as a major problem at the largest department of computer and systems sciences in the Nordic countries (Allen, et al., 2008). It has been shown in many studies including (Allen, et al., 2008; McGaha & Fitzpatrick, 2005; Nicpon, et al., 2006) that the inability to complete a thesis mainly contributes to increasing dropout rates in many degree programs. On the other hand, failures in the thesis process may not solely depend on the student's inability to perform the tasks in the thesis process. Physical limitations to exchange ideas with supervisors and peers; lack of continuity of assessment of the quality of work; missing important information about the thesis project and the process; lack of chances for comparison of performance with peers due to isolation; lack of infrastructure or academic support from the institutional perspective, and so on may also be contributing to hinder the success (Aghaee, 2015; McGaha & Fitzpatrick, 2005; Nicpon, et al., 2006).

How to maximize the throughput of the theses in universities has been a topic of investigation for many years, as performance rate of thesis projects is important in maintaining the reputation of the academic institution. The quality and completion rate of the theses at universities can be increased by improving the quality of the thesis process, increasing supervision hours, increase of group projects, changing evaluation procedures, student counselling, including courses for how to conduct research work into curriculum, meta supervision, engaging the students in the ongoing and practical projects, encouraging close ties with the industry so that the students get the motivation to complete and continue working in the same industry, and so on (Karunaratne, et al., 2017). Among the other factors, interaction plays a major role according to (Aghaee, 2015). There can typically be three types of interaction, student – content, student-student, and student – supervisor (Goodyear & Ellis, 2008). Student – supervisor interaction is the central among other interactions, as supervisors agreement is a major factor for the success of the thesis (Soares da Costa , 2016). However, the student – supervisor interaction is individualistic and driven by the preferences and specific styles of supervision (Hansen & Hansson, 2016). Literature provide categorizations of supervision styles based on their nature of supervision. E.g. Dysthe (2002) identifies three types of supervisors. Supervising as a teacher, where the student follows the supervisors' instructions during the study, resembles the conventional form of teaching. A friendly atmosphere with more distributed responsibility is created in the partnership model. The

Reference this paper: Karunaratne, T., 2018. Blended Supervision for Thesis Projects in Higher Education: A Case Study. *The Electronic Journal of e-Learning,* 16(2), pp. 79-90, available online at www.ejel.org

third model Dysthe (2002) brings in is the model of apprenticeship, where the student is in a partnership that is influenced by the authority of the supervisor. Seven different types of supervisors are listed in (Soares da Costa , 2016), namely, the know-it-well, absent, the perfectionist, very hands-on, the pessimist, the friend, and the coach. The differences of the supervision models are based on how the supervisor instructs the students, how do they deal with the guidance to writing, resource discovery, and sharing, frequency and forms of supervisor meetings, etc, (Karunaratne, et al., 2017). Accordingly, supervision styles in general are influenced by the individual preferences of the supervisors when deciding on when to meet, how often, and where and how to communicate (face-to-face, forum, voice conferences, etc.). Some supervisors prefer ad hoc meetings, that is, scheduling a meeting when students have problems or when they request for a meeting. Other supervisors prefer regular and pre-planned face-to-face meetings individually and/or in a seminar form with fellow students. Some supervisors rely solely on distance technology in supervision due to many reasons including demographic distance. However, many of the related studies have pointed out the relation between the flows of supervision and student drop out from thesis projects (Dysthe, et al., 2006; de Kleijn, et al., 2012).

Automated systems that support student and course management have been in use in education for many years. The efficiency and effectiveness of these systems, especially when scaling up of the programs to meet the increasing demand for education, are shown in many related studies. For example, the IT-system for thesis support, SciPro (Supporting the Scientific Process) (Hansson, et al., 2009) manage hundreds of students on average per academic semester, where about two thirds of them are at the Bachelor's level (mainly Swedish students) and the rest are at the Master's level (mainly international students). They interact with approximately fifty supervisors who also present themselves, their research topics and preferred mode of supervising in the system. The system provides support for matching between students and supervisors, accessing supervisor /student information, querying from thesis and supervisor support facilities, referring and sharing learning content such as video films and other related materials, booking seminars, use of the peer and supervisor discussion forums, managing the milestones in the thesis process, etc. (Karunaratne, et al., 2017). The support provided by such an ICT system could complement the thesis supervision process in such a way that the supervisor need not necessarily be avaialble for many parts of the thesis process, yet the student receive all the support needed to fulfill his or her tasks.

This study investigates how does the blending of ICT complement thesis process. Therefore it explores the effect of the IT support system in reducing the issues in thesis supervision and retention of dropout students. The Department of Computer and Systems Sciences (DSV), Stockholm University and the thesis support system SciPro is taken as the case to investigate. Thereby an effort is taken to demonstrate a case of blended supervision and how it bridges the gap of the student supervisor communication problems.

The rest of the paper is organized as follows. The next section focuses on the domain in focus and the use of blended supervision at DSV. Section three describes the methods we adopt to investigate how blended supervision affects the quality and the number of theses produced at the department, followed by the results and the discussions and finally, conclusions drawn from this investigation and possible further works.

2. Background and the domain in focus

At the Department of Computer and Systems Sciences (DSV), students at Bachelors level take a thesis worth of 15 credits during the final term of the third year of the program. Masters level thesis work carry 30 credit points. As stated above, in 2008, a large-scale evaluation about education conducted at the department suggested improving the quality and the number of thesis projects at the department. An ICT support system has been introduced in the department to support the thesis process with the aim of addressing the following issues:

- Students struggle in finding a supervisor, resulting in delays in starting the thesis project
- Supervisors spend most of their supervision time for management of the thesis leaving very fewer opportunities for students to get feedback and coaching in the actual research work
- Quality control of the thesis is difficult due to the complexity of collaboration with the supervisor, reviewer, peers, thesis opponents, as well as active participants in the final seminar.
- Communication with the supervisors is difficult since planning supervisor meetings require contacting them personally to agree on supervision times. Students may need to knock the door to see the availability of the supervisor or communicate many times via emails, etc.

- Supervision process is not transparent, therefore, if there is any issue related to supervision, the student become isolated, and get lost in the process
- Planning the final defense is difficult as it involves many parts, such as reserving the time of the participants and reserving a venue, submitting the thesis and controlling for plagiarism, managing the opponent and active participants, etc.
- Difficulty in tracking the resources used or discussed during the thesis period, and, managing and providing feedback for the thesis draft at different levels.
- Finding relevant information for thesis work, including general and specific literature, thesis templates, and other required resources
- Supervision and management of students taking thesis in distance programmes

2.1 Thesis process at the Department of Computer and Systems Sciences (DSV)

The thesis process at DSV is structured as illustrated in Figure 1 below.

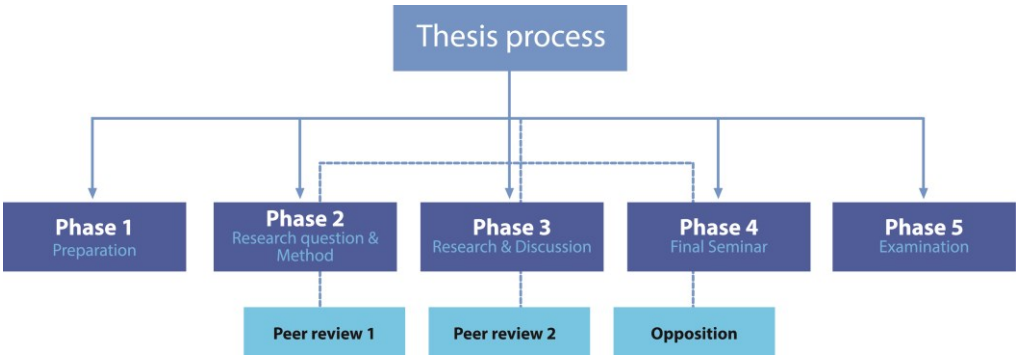

Figure 1: Thesis process at DSV (Source: https://thesisinfo.dsv.su.se/thesis-process)

The complete thesis process at DSV consists of five phases, 1) preparation, 2) research question and method, 3) results and discussion, 4) final seminar and 5) thesis examination. What functions the students and supervisors perform during each phase is listed in Table 1.

Table 1: Student and Supervisor tasks in the thesis process

Phase	Student	Supervisor
Initiation	Students fulfill prerequisites for writing the thesis	Supervisors are allocated a quota of students for the term
Phase 1	• Find a thesis topic (idea) or choose from available ideas from supervisors • Hold the first meeting with the supervisor to agree upon/ refine the topic and plan the research • Create/modify a project proposal	• Submit ideas at least to fulfill the allocated quota, or pick an idea from students • First meeting with the student to plan the research • Feedback/ approve the project proposal (can be iterative)
Phase 2	• Create the research questions and methods • Improve the thesis draft based on feedback from the supervisor • In the case of supervisor/reviewer reject the draft of the thesis, upgrade it until its approved • Make the thesis draft available for other peers to review • Review two other student theses at the same level	• Advice and re-evaluate research question and methods (this can be iterative) • Approve the draft of the thesis and send to a reviewer (another professor at DSV) (this can be iterative until the reviewer approves the draft)
Phase 3	• Conduct the empirical study/ experiment/data collection • Complete thesis draft, get supervisors' approval and make it available for 2nd peer review • Review two other thesis drafts	• Advice and guide student/ provide feedback
Phase 4	• Finalize the thesis draft • Submit the thesis in the platform once the supervisor finalizes the final seminar arrangement • Be an opponent for another final seminar and actively participate in two other final seminars (register in the platform)	• book a date and room for a final seminar • assign the numbers of active participants to the final seminar • Plagiarism control of the submitted thesis • Host the final seminar
Phase 5	• Upgrade the thesis draft based on the feedback received in the final seminar • Submit the final draft	• Evaluate the final draft and grade the thesis • Check if all the peer reviews and oppositions are completed • Coordinate with the panel of examiners for finalizing the grade • Report the grade obtained and achieve the thesis

The thesis process at DSV is complex and requires extensive collaboration among not only the student and the supervisor, but also the co-supervisors if any, the reviewers, and the examination board as well as fellow students who participate in peer reviews. The thesis support system SciPro takes care of many of the activities in the thesis process as discussed in (Karunaratne, et al., 2017; Larsson & Hansson, 2013; Larsson & Hansson, 2011). The main information and communication channels of the thesis process is presented in Figure 2.

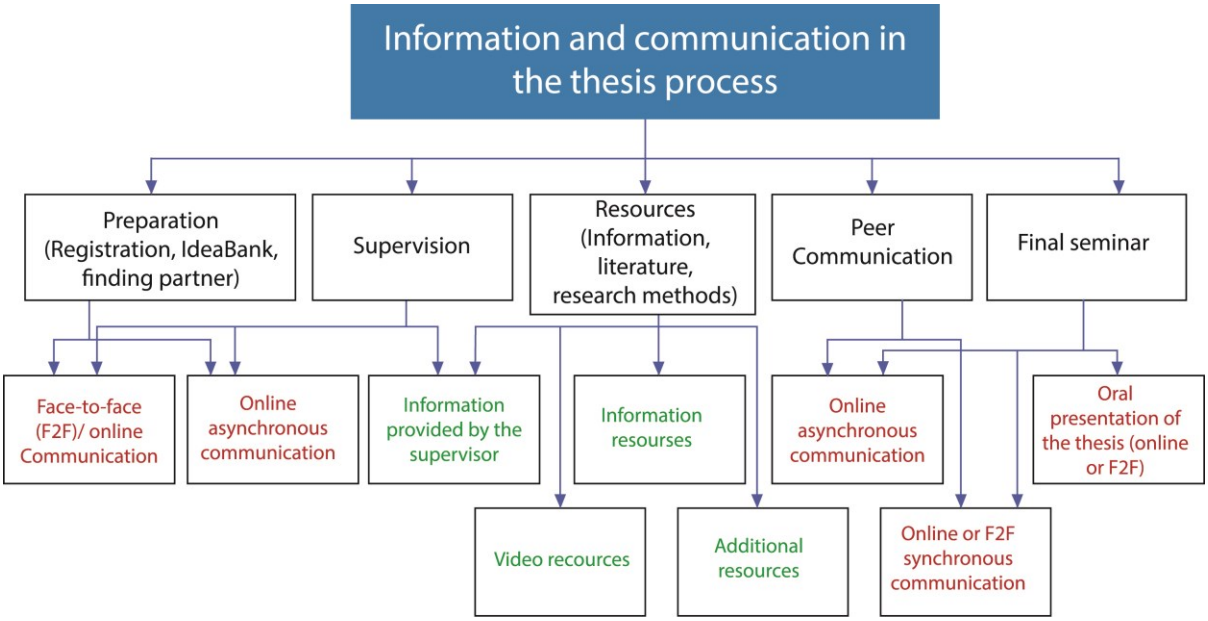

Figure 2: information and communication channels in the thesis process (ref: Karunaratne, et al., 2017)

In a thesis project, students interact with content (thesis draft), with peers and with supervisors. At each of these interactions there exist questions to answer. Table 2 gives a summary of those interactions.

Table 2: Interactions in thesis process (ref: (Karunaratne, et al., 2017))

Entity	**Interaction**
Self-assessment	Checklists: First meeting: 9 questions Project plan: 11 questions Rough draft: 9 questions Result and discussion: 11 questions A complete thesis version 1: 22 questions A complete thesis, revised: 22 questions Grading criteria: 18 aspects
Peer review online (peer review 1 and 2)	Project plan: 11 questions Rough draft: 9 questions Result and discussion: 11 questions
Peer review in final seminar (Opponent 1)	Written opposition report aligned with the grading criteria (18 aspects) Oral presentation and discussion
Peer review in final seminar (Opponent 2)	Written opposition report aligned with the grading criteria (18 aspects) Oral presentation and discussion
Peer review seminar: Active participants	5-15 oral questions
Reviewer	Rough draft approval: 6 aspects
Reviewer	Final seminar manuscript approval: 18 aspects
Reviewer	Grading: 18 aspects
Supervisor	Oral and written feedback throughout the whole process, including validation, summaries and comments of feedback listed above: individual supervision, seminars, and online forums. Estimated: feedback aligned with grading criteria: 18 aspects x 6 times
Supervisor	Grading: 18 aspects
Examiner	Grading and reporting: 18 aspects
Total	316 interactions

2.2 Blended approach for thesis supervision

Blended learning is ubiquitous in education, especially with the rapid evolvement of ICTs in education. As a result, tools and technologies that can be used to blend traditional classroom teaching and learning process have been emerging in recent years (Garrison & Kanuka, 2004). However, the blended form of thesis supervision has gained comparatively less attraction. Some examples of blended supervision can be found in the field of medical and health sciences, specifically in laboratory experiments, practicing medical surgeries, simulations of the body, visualizing natural phenomena and so on (Ingham & Fry, 2016). Blended forms of supervision by a group of supervisors, with the focus of the effect of integrating the expertise of supervisors of different areas of strengths together by efficient collaboration using ICT tools, is discussed in (Donnelly & Fitzmaurice, 2013),.

ICT can be supportive for blended supervision such that important information, guidelines, and related resources could be structured into the thesis support system to allow students access without the guidance of the supervisor. Such a facility saves a lot of the supervisor's time of repeating the same information to all the students s/he supervises (Hansen & Hansson, 2016). The ability to organize virtual meetings cuts down traveling times for physical meetings, and allows having the meetings at flexible times. The space for synchronized and asynchronized communication via an online forum reduces communication gaps (Aghaee, et al., 2013). Table 3 shows which supervision tasks can be offered using ICT.

Table 3: The blended model of supervision

Supervisors tasks	**Mode and method of performing**
Supervisors are allocated a quota of students for the term	Information is present in SciPro.
Submit ideas at least to fulfill the allocated quota, or pick an idea from students	Upload to the idea/s section of the SciPro system. Check available ideas
Filling the quota of students by selecting student ideas or student pick from the entered ideas by the supervisor	The system automatically matches the idea once selected and create a thesis project in SciPro.
Arrange first meeting with the students matched	Booking the meeting is done via SciPro.
Research plan is created together with the student	Create in SciPro.
Advice on the research topic /provide feedback	Face to face or online meeting. Summary of the discussion and resources exchanged can be archived in SciPro.
Approve the project proposal	Via SciPro.
Advice and re-evaluate research question and methods	Literature is in Thesis info pages in SciPro
Send the first draft to a reviewer (another professor at the department)	Via SciPro (Interaction with reviewer)
Reviewer communication with supervisor for clarifications etc. if needed	Via SciPro (Interaction with reviewer)
Advice and guide student/ provide feedback during the empirical study/experiments	Face to face and/or via SciPro
Approving the final draft	Via SciPro
Check requirement for final thesis, i.e., if all the peer reviews are completed	Information are already in SciPro after the task is fulfilled
Book the final seminar	Via SciPro
Plagiarism control for the submitted thesis	Automatically done in SciPro
Host the final seminar	Face to face or online
Grade the thesis	Grading criteria is in SciPro; supervisor fills in the relevant parts of it. The final grade is automatically calculated
Coordinate with the panel of examiners for finalizing the grade	Communiation via SciPro
Report the grade obtained and achieve the thesis	Grade is automatically sent to the student management system from SciPro

It is pointed out that the new and developed criteria for improving the quality of the thesis process at DSV would be nearly impossible to perform without increasing the supervision hours accordingly unless ICT support is present (Aghaee, et al., 2013).

3. Data and methods

As stated above, this study investigates the effect of the ICT support system used at the Department of Computer and Systems Sciences and thereby try to answer the questions of 1). What problems in the thesis process have been solved by blending of ICT in thesis process 2). How the SciPro system does supports blended supervision and 3). How has the quantity and quality of the theses improved over the years at DSV. The strategy followed in the study include both explorative (qualitative) and quantitative approaches.

3.1 Data and data collection methods

Qualitative data: The data collection strategy chosen in this study is the survey methodology. Interviews are conducted to investigate the issues related to the thesis process at the department, To study the blended supervision process, and how ICT smooths out the supervision process, four supervisors are selected randomly, and their perceptions were captured via deep interviews. The interview also aimed at understanding the challenges the department faced in offering the thesis projects at Masters and Bachelors levels before the SciPro system is implemented. Interview questions were related to 1) the supervisor's experience and practices before the reforms to the thesis process. 2) challenges of supervision, and, 3) the experience and practices after the reforms and ICT is introduced.

Quantitative data: Data accumulated in the SciPro system is the quantitative data used in the study. The "completed thesis" dataset consists of the information about completed theses at DSV since 2008. There are 2609 entries in the dataset which each instance correspond to information of a student who completed theses during seven years from 2008. Altogether there are six attributes, namely, Thesis ID, Student Name, Supervisor Name, Thesis topic, Date completed, and Grade obtained. Thesis ID is of type numeric, and date completed has the data type Date. The rest of the attributes are of type string. The user logs dataset consists of a set of user click logs of the system in the period from 2013 January to 2015 May. This log data is pre-processed into attribute-value form with 21 attributes of the functions listed in Table 3. The data set consists of 43500 entries.

3.2 Data analysis methods and tools

Both qualitative and quantitative data analysis methods are used. A triangulation approach (Bogdan & Biklen, 2006) is followed where the interview data are triangulated with the quantitative data. Maxqda (MAXQDA, 1989-2016) is used for transcribing and analyzing the interviews. The visualizations and summarisations of the quantitative data are carried out using R (R Core Team, 2014).

4. Results and discussion

This section presents the results of the empirical study

4.1 What problems in thesis process has solved by blending of ICT in thesis process.

Starting the thesis: Results from the transcribed interview data revealed that the main bottleneck in the thesis projects at DSV in the pre- SciPro era was regarding the matching of student thesis topics with suitable supervisors. The coordinator of the thesis projects explains

> *"I had to knock the doors to request if the supervisors are willing to take those (students) who are struggling to find a supervisor."*
>
> *"Some supervisors tend to quickly pick the good students (who were performing better in the courses). I (myself) had to supervise more than ten students with lower grade point averages (per term)."*
>
> *"There was no systematic allocation of students for supervisors."*
>
> *"The matching of students to supervisors happened throughout the year, making it very difficult to provide orientation facilities for students starting thesis work."*
>
> *"It is natural that some students waste weeks of their study time trying to find a supervisor."*

SciPro matching of supervisors to students is autonomous, and the log data of SciPro shows that the matching has been done well ahead of the official start of the thesis process. This allows students to utilize a complete 20 or 10 weeks to engage in conducting their study. Figure 3 is a plot of the number of days between the

actual start of the thesis and the student finds a supervisor during the period of January 2013 to February 2015.

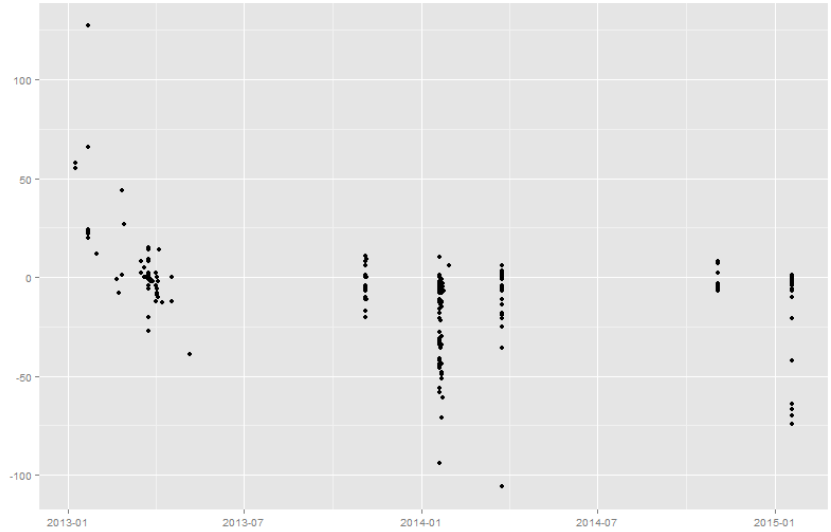

Figure 3: number of days from finding a supervisor to the official start of thesis project

Figure 3 shows that most of the thesis projects at DSV nowadays start on time, and by the time of start all the students have supervisors for their thesis projects. The dots of the scatter plot in Figure 3 around January corresponds to the date of start of both Bachelors and Masters Theses. Bachelors thesis of 15 credit points starts in April and October as well.

Supervision time and communication with the student: According to the outcome of the interviews, communication between the supervisor and student was problematic without the support from the ICT system.

> *"Complaints from students about communication issues with the supervisors were not surprising"*

> *"Coordinator receives many emails per day about not knowing the deadlines, and various other missing information"*

> *"I had to repeat the same information to many students, and still there could be a chance that I missed one student"*

> *"I and many of my colleagues find it difficult to manage with student communication especially when I am traveling abroad for longer periods. It is not surprising if I miss student's emails in my over flowing mailbox"*

> *"The threads of the communications I had with my students is not easy to trace, so sometimes I am not sure what we agreed previously"*

SciPro focuses mainly on clear communication and providing structured information. SciPro thesis information pages include all the required information in a structured way so that any student can find them very easily (Aghaee, et al., 2013). The interviews justified this fact as follows:

> *"I am no more worried about students miss information. Instructions are provided to students in the beginning"*

> *"In the back seat of a bus in rural Africa with my roaming broadband I could provide feedback to my students"*

> *"In a day during the period of reporting the grades myself and many other supervisors were in a presentation and at the same times SciPro is opened in our laptops"*

SciPro functions that allow collaboration among the students and supervisors include *Forum*, which is the messaging service of SciPro and the *Files*, which is the file archive in SciPro. These facilities have become popular with the time as can be seen by the log data analysis results in Figure 4. Figure 4 (top) shows the frequency of using the Forum function each day of the year. High frequency of usage corresponds to the active period of the thesis. Similar pattern exists in the usage pattern of uploading files (bottom figure) as well. The usage also increases each year.

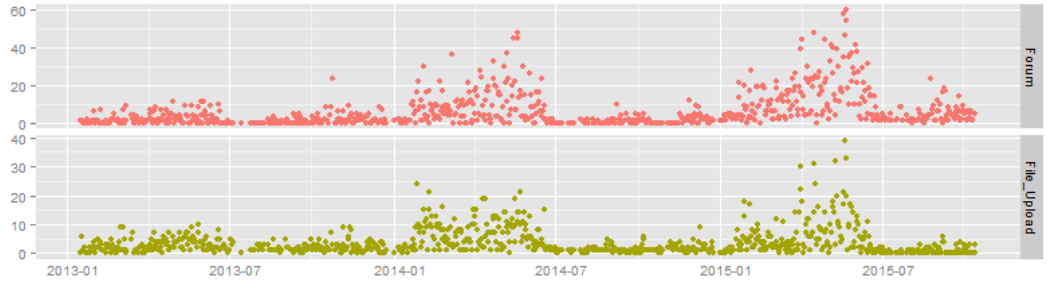

Figure 4: Usage of Forum and Files function

Communication among the student, supervisor, and reviewer: Communication among the stakeholders in the thesis project had many gaps, due to delays in responses, but communication via SciPro is transparent which motivates supervisors and reviewers to respond timely. For example

> *"Whenever the student or the reviewer (supervisor) perform an activity I receive a notification, which I can respond even without login into SciPro. The discussion is saved in Forum so the thread of communication is visible":*

> *"I make sure myself to respond quickly since the delay is visible otherwise"*

The role of a reviewer is introduced to the thesis process from the year 2014 onwards. The functions of communication with the reviewer have been evolved during the time as well according to Figure 5. These to functions are used only two times per thesis. So one may not expect high frequencies here compared to that of Figure 4.

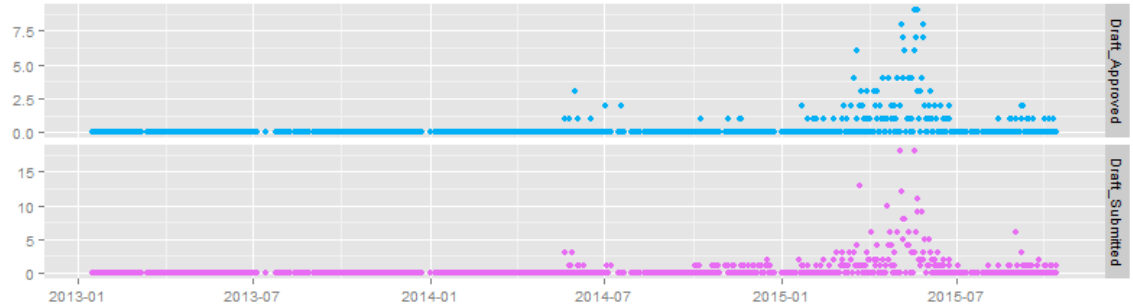

Figure 5: Communication with the reviewer

4.2 How does the SciPro system support blended supervision

As illustrated in Table 3 many supervision activities are completely delegated to SciPro system. Some other activities, such as managing student queries, etc. has become efficient. The interviews justified how it becomes easy and efficient for the supervisors. E.g., Supervisors state:

"I do not need to check many places for information. All my projects can be checked from one place, it saves lots of my time"

"If I am not sure what to do next (in the thesis process) I can go to SciPro and check it"

"I think it is the volume of information that I can handle in SciPro very efficiently"

"The checklists in SciPro tells the students what they are supposed to do. So I save half of my time"

"Students are much more prepared now than before even in the first meeting"

"Selection of students are based on ideas, not any other preferences, so both student and supervisor have a topic that they like to work with"

"I can easily fill in my quota of students with the ideas I like or I posted in SciPro idea bank"

"Organisation of final seminar is the most efficient"

"The planning features in SciPro is great and saves a lot of my time"

"Automated grading criteria saves time as well as I don't miss any point of the 18 parts of it in grading. It also allow easily compare my grading with the reviewer and examiner panel's"

"System is in the cloud, so I can supervise and manage students from anywhere in the world"

Supervisor perceptions justify the success of the blended supervision model adapted in the SciPro system. Further, the quantitative data shows that the number of available supervisors has not been increased in the department proportionately to the number of students enrolled in (and completing) the thesis at the department. Figure 6 shows the number of supervisors involved each year and the number of students completed the thesis project during 2008-2014.

Figure 6: Number of supervisors and number of completed thesis at the department during 2008-2014

Thesis completion at the department was increased from 59 to 557 during a seven years' period as shown in Figure 6. However, the rate of increase of the number of supervisors are less than that of students, i.e., from 20 to 112, which has resulted in an average of twice as many students are supervised now by supervisors at the department compared to 2008. This increase in the throughput was in parallel with improving the quality of the thesis. This justifies that the blended supervision model allow supervisors handle more students than before.

4.3 How did the quantity and quality of the theses improved over the years at DSV?

Figure 6 above showed the increase of the numbers of completed theses from 2008, but how has the quality changed over time? A thesis at Bachelors or Masters Level receives a grade in A-E scale. There is no fail in the thesis, which means if the thesis is not up to the standard of a pass (Grade E) then the thesis is not completed. In Figure 7 completed theses are categorised into three groups (excellent, good and fair) and shows the number of excellent (A, B) grades, good (C) and fair (D, E) grades obtained by the completed thesis during 2008-2014. The improvement of the number of excellent grades and the respective drop of the number of fair grades justifies the quality improvement of the thesis process. With the moderate increase of the good grades, it can be assumed that some of the theses that could end up fair grades were able to raise for good grades and good to the excellent.

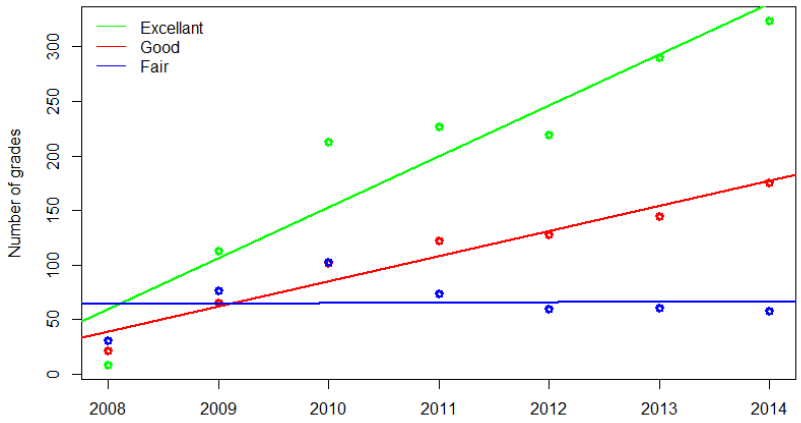

Figure 7: Number of Excellent, good, and fair theses at DSV during 2008-2014

5. Summary and Discussion

The results of this study showed the impact of using an ICT system during the whole thesis process with respect to the supervisor perspective. It showed the improvement of information accessibility, communication and collaboration. Hence, the activities that impact most in the supervisors' point of view are summarised as follows.

Thesis Administration:

- Matching with suitable supervisors and students
- Allocating peers and reviewers
- Allocating venue and composition for final seminar/ public defense of thesis
- Controlling the thesis for plagiarism
- Administrating the grading and reporting

Thesis Supervision:

- Scheduling/conducting meetings and activities
- Delivery/exchange of relevant information
- Punctuality in providing feedback and other necessary information
- Transparency in communication

Collaboration:

- Self-assessment of student's work
- Peer interaction
- Reviewer interaction
- Transparency in interaction

Further, the blended supervision model presented in Table 3 is shown to be effective, since it has enabled the department to implement the improved thesis process, which contributed to enhancing the quality of the theses produced at the department. Neither were additional hours required to be allocated to supervisors, nor was the number of supervisors increased to facilitate the increasing numbers of students. Therefore, both the quality and the quantity of theses at DSV has been improved by the support of the ICT system and blended supervision model.

6. Concluding remarks

To support a comprehensive thesis process aiming to solve the issues related to Masters and Bachelors theses, the Department of Computer and Systems Sciences introduced a blended form of supervision. How the use of ICT helped in improving the quality and quantity of the theses at the department and how the blended supervision model facilitated are investigated in this study. The supervisor's perceptions of blended supervision practiced in the department were captured via interviews. The descriptive data about the completed theses and the log data of the SciPro thesis support system are used to complement supervisors' perceptions. The results showed that the use of ICT system has enabled an efficient and effective thesis process. The blended model of supervision helped supervisors for enhanced collaboration and efficient management of the thesis project, resulting in an improvement in the thesis quality and quantity over the time. This study, however, did not cover if there are any differences in the perceptions or the use of the ICT support system, concerning different supervisor types. Such a study would be a future extension of this work. Furthermore, use of ICTs creates an internal digital divide among the users, which has not been investigated here and left for further studies.

References

Aghaee, N., 2015. Finding Potential Problems in the Thesis Process in Higher Education. *Education and Information Technologies,* 20(1), pp. 21 -36.

Aghaee, N., Hansson, H. and Drougge, U., 2013. Facilitating Autonomous Learning in Higher Education. *European Journal of Open and Distance Learning.*

Allen, J., Robbins, S. B., Casillas, A. and Oh, I. S., 2008. Third-year college retention and transfer: Effects of academic performance, motivation, and social connectedness. *Research in Higher Education,* 49(7), pp. 647 - 664.

Bogdan, R. C. and Biklen, S. K., 2006. *Qualitative research in education: An introduction to theory and methods. Allyn & Bacon.* s.l.:s.n.

de Kleijn, R. A. M. et al., 2012. Master's thesis supervision: relations between perceptions of the supervisor–student relationship, final grade, perceived supervisor contribution to learning and student satisfaction. *Studies In Higher Education ,* pp. 925-939.

Donnelly, R. and Fitzmaurice, M., 2013. Development of a Model for Blended Postgraduate Research Supervision in Irish Higher Education. *Emerging Issues in Higher Education III, From Capacity Building to Sustainability,* pp. 1-18.

Dysthe, O., 2002. Professors as mediators of academic text cultures: An interview study with advisors and masters degree students in three disciplines in a Norwegian university. *Written Communication,,* pp. 485-536 .

Dysthe, O., Samara, A. and Westrheim, K., 2006. Multivoiced supervision of Master's students: a case study of alternative supervision practices in higher education. *Studies In Higher Education,* pp. 299-318.

Garrison, D. R. and Kanuka, H., 2004. Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education,* pp. 95-105.

Goodyear, P. and Ellis, R. A., 2008. University students' approaches to learning: rethinking the place of technology. *Distance Education,* 29(2), pp. 141-152.

Hansen, P. and Hansson, H., 2016. Optimizing student and supervisor interaction during the SciPro thesis process – concepts and design. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics),* p. 245–250.

Hansson, H., Collin, J., Larsson, K. and Wettegren, G., 2009. Open and flexible ICT-support for student thesis production - Design concept for the future. *The Cambridge International Conference on Open and Distance Learning .*

Ingham , G. and Fry, J., 2016. A blended supervision model in Australian general practice training. *Australian family physician,* pp. 343-353.

Karunaratne, T., Hansson, H. and Aghaee, N., 2017. The effect of multiple change processes on quality. *Assessment in Education: Principles, Policy & Practice,,* pp. 1-17.

Larsson, K. and Hansson, H., 2011. *The challenge for supervision: Mass individualization of the thesis writing process with less recourses.* Berlin, Online Educa .

Larsson, K. and Hansson, H., 2013. Anti-plagiarism strategies How to manage it with quality in large scale thesis productions. *Educational Integrity,* 9(2), pp. 60-73.

MAXQDA, 1989-2016. *Software for qualitative data analysis.* Berlin: Sozialforschung GmbH.

McGaha, V. and Fitzpatrick, J., 2005. Personal and social contributions to dropout risk for undergraduate students. *Collage student Journal,* 39(2), p. 287.

Nicpon, M. F. et al., 2006. The relationship of loneliness and social support with college freshmen's academic performance and persistence. *Journal of College Student Retention: Research, Theory and Practice,* 8(3), pp. 345 -358.

R Core Team, 2014. *R: A language and environment for statistical computing,* Vienna, Austria: R Foundation for Statistical Computing.

Soares da Costa , T. P., 2016. Supervisor types: which one is your match?. *Cell Death Discovery,* 2(16060).