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Lifting Information Literacy in Ergonomics – A Case Study of Master Degree Projects Presented at the KTH Royal Institute of Technology, Stockholm, Sweden

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LIFTING INFORMATION LITERACY IN ERGONOMICS –
A case study of integrated information literacy teaching at the KTH Royal institute of technology, Stockholm, Sweden.

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Abstract

Aim: The aim of this study is to analyse the effect of integrated information literacy teaching activities in project and theses courses from the 2nd cycle at KTH Royal Institute of Technology. The effect is studied by analysing a set of master[1] theses in Ergonomics presented during the years 2010-2016. This time frame coincides with an increase in the integrated information literacy teaching provided by the KTH Library for the master program in Ergonomics.

Method: We use an interpretative content analysis and a dynamically developed coding scheme to extract data concerning how the master theses incorporate and use earlier research in the theses. We use data collected from interviews with the Ergonomics faculty at KTH and responses to a survey of other Swedish technical university libraries to further analyse strengths and weaknesses in the information literacy teaching provided. We study the master theses in Ergonomics and Human-Technology-Organisation (HTO) presented at KTH and a selection of older master theses from Linköping University.

Results: The analysis shows that the increased presence of integrated information literacy teaching activities, together with a curriculum development made by the Ergonomics faculty, has led to improved master theses at KTH. We therefore claim that there is an increase in information literacy skills over time in students who completed the master degree in Ergonomics. Our preliminary recommendation is that our teaching approach can be fruitfully implemented in other master programs at Swedish technical universities, but there is a need for further studies.

Novelty: This is one of the first studies of the impact of integrated information literacy teaching activities on Swedish thesis works. It adds knowledge on the quality of master students' use of scientific information in thesis writing.

Limitations: This study does not investigate information literacy skills obtained during candidate or PhD-studies, and it does not discuss possible impacts of academic information literacy teaching on the life-long learning process in students.

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[1] The theses are both from one-year and two-year master degrees; see detailed description under data collection. It would therefore be better to refer to them as "degree project works on the second-cycle level", but we settle for "master theses".

Keywords: engineering students, thesis writing, degree project works, integrated information literacy teaching, community of inquiry

Introduction

The Swedish Higher education act, Chapter 1, Section 8 & 9 states that:

"First-cycle courses and study programmes shall develop:
- the ability of students to make independent and critical assessments,
- the ability of students to identify, formulate and solve problems autonomously, and
- the preparedness of students to deal with changes in working life.

In addition to knowledge and skills in their field of study, students shall develop the ability to:
- gather and interpret information at a scholarly level,
- stay abreast of the development of knowledge, and
- communicate their knowledge to others, including those who lack specialist knowledge in the field. Ordinance (2009:1037).

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Second-cycle courses and study programmes shall […]:
- further develop the ability of students to integrate and make autonomous use of their knowledge,
- develop the students' ability to deal with complex phenomena, issues and situations, and
- develop the students' potential for professional activities that demand considerable autonomy, or for research and development work. Ordinance (2006:173)"[2]

These statutes are reflected in phrasings in the aims and objectives for the degrees of Bachelor and Master of Science (in Engineering), as well as in different definitions of information literacy. For example, the program objectives for the degree of master in Ergonomics and HTO: https://www.kth.se/student/kurser/program/TERGM/HT16/mal?l=sv

If we compare these degree aims and objectives with the ACRL standards of information literacy: http://www.ala.org/acrl/standards/informationliteracycompetency, we find that information literacy can be seen as a necessary skill to obtain for the engineering student in order to fulfil the program objectives.

Outline

Our main study object will be a set of 27 master theses, hereafter called S. A complete list of the elements in S is available in Appendix A.

The outline of this paper is as follows. We first describe the data collection process and the study design. We then describe the coding scheme used. We then describe the coding process. After that, we analyse the coding. We then describe the interviews made with members of the faculty of Ergonomics at the KTH Royal institute of technology and analyse the interviews. At last, we summarise the paper by giving some recommendations for future work.

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[2] Unoffical translation, available on: https://www.uhr.se/en/start/laws-and-regulations/Laws-and-regulations/The-Swedish-Higher-Education-Act/ .

Definitions

A *coding scheme* is set of terms used for describing the content of a set of texts. A coding scheme is an *information literacy coding scheme* if the coding scheme consists of descriptions on how the texts use citations and references to earlier research. A *content analysis* is the process of assigning codes from a coding scheme to a set of texts. A content analysis is an *interpretative content analysis* if the coding process is performed by manually reading the set of texts and manually assigning codes. A content analysis in *dynamic* if the coding scheme is developed or modified during the coding process.

Observation: The coding scheme used by B Gunnar Malm in (Malm, 2015) is an interpretative dynamic information literacy coding scheme and hence he performs an interpretative dynamic information literacy content analysis in that paper. We judge that his coding scheme can be used and further developed on our set of master theses.

Data collection

The master program of Ergonomics was moved from Linköping University to KTH during the academic year 2008/2009. It had been given since 1996 under the name "Magisterutbildning i ergonomi", first at collaboration with Arbetsmiljöinstitutet in Stockholm, then later at the department "Institutionen för konstruktions- och produktionsteknik" (IKP) at Linköping University, which later changed name to "Institutionen för ekonomisk och industriell utveckling" (IEI). The total number of students admitted to the program in Linköping was around 130, with an estimated 50 % completion rate (Eklund, 2016).This estimation gave us around 50-70 theses to study from Linköping.

The master program in Ergonomics at KTH is a one-year master (Swedish: "magister") program, which is given every other year on full pace and every other year on half pace.[3] This results in a number of students already working in a profession. Sometimes these students have been away from academic studies for a long time, which causes a lack in academic competences, in particular information literacy skills. On the other hand, the students often show a deep knowledge in the practical working fields of Ergonomics and Human-Technology-Organisation. This means that the challenges in teaching information literacy for these students are different from teaching most KTH bachelor level programs.

A detailed search in KTH DiVA[4] resulted in 42 full-text available master theses connected to Ergonomics department at KTH from 2010-2016.[5] The search was compared with a search made by the KTH DiVA support[6] and the search results were the same. By manually reading the theses, in particular the title pages, we identified 27 of those theses as being in Ergonomics and MTO.

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[3] https://www.kth.se/student/kurser/program/tergm/ht16/arskurs1?l=en

[4] KTH Diva: http://kth.diva-portal.org/smash/search.jsf?rvn=8&dswid=-7800. Accessed multiple times during 20160701-20161201.

[5] The search string: http://kth.diva-portal.org/smash/resultList.jsf?dswid=-7194&language=en&searchType=UNDERGRADUATE&query=&af=%5B%5D&aq=%5B%5B%5D%5D&aq2=%5B%5B%7B%22organisationId%22%3A%2214360%22%2C%22organisationId-Xtra%22%3Atrue%7D%5D%5D&aqe=%5B%5D&noOfRows=50&sortOrder=author_sort_asc&onlyFullText=false&sf=all [used 2017-01-30] resulted in 42 hits, with two hits being metadata of the same theses and some theses affiliated to a related master program (called "Magisterprogrammet för teknik, hälsa och arbetsmiljöutveckling "). After manual inspection, the abovementioned 27 master theses were identified as being written in Ergonomics.

[6] Thanks to David Scheutz for help.

We first thought of comparing S with Ergonomics theses completed at Linköping, preferably from those available in digital full text. But after multiple consultations with people and organizations at Linköping University, for example the university archive and registrar, as well as the departments responsible for the Ergonomics master program, we realized that there were very few theses available in digital full text.

Hence, we decided to skip the detailed comparison and instead focus upon comparing the progress of information literacy skills in the master students of Ergonomics at KTH 2010-2016. We thus defined S to be the 27 theses as listed in Appendix A. We recognised the weakness of this design and decided to add additional data from faculty, obtained by a survey and interviews. The result of the survey is reported in (Hamrin, 2016). Statements obtained in the interviews are reported below.

During the interviews, we were informed by the existence of some of the older master theses from Linköping available in print at the Ergonomics faculty department library. We were given access to that library during February-March 2017, and hence we could perform a similar content analysis on a small pseudo-random collection of these older theses.

Coding scheme

In the paper (Malm, 2015), B Gunnar Malm (BGM) from KTH School of Information and Communication Technology makes a short study of the citation practices by 10 student theses writers, one from each KTH-school. BGM develops a coding scheme, inspired by the practice of *use cases* from computer science, in which he characterises the references made in the master theses. His aim is not to study *what* sources that have been used by the students, but *how* the students use earlier sources; he aims to *identify the nature of the references made in the text* to earlier research. His final coding scheme looks like:

C1 strengthening a statement

C2 fact

C3 datasheet

C4 technical documentation

C5 formal definition

C6 argument

C7 contrasting or conflicting opinion

C8 background survey

C9 avoiding having to write-up

c10 data source

c11 statistics

c12 legislation

c13 press

c14 white paper

c15 standard

Note: This is my phrasing of the codes used in (Malm, 2015).

Coding process

The coding process was started by using BGM's initial coding scheme. During the coding, we expanded the scheme with one new code (c16, called "OTHER") and added "critical analysis" to the code c7, resulting in the category "(critical analysis or) contrasting or conflicting opinion". We also iterated the coding process by going back and revising the coding, when we judged it was necessary to adjust the coding. In the end, the vast majority of the reference notes used by the students were concentrated into a few of the 16 categories.

We alone coded the material. We recognise the weakness in this method, for example see the interdependent indexer consistency discussion in (Monreal & Gil-Leiva, 2011). For details, see our earlier work (G. Hamrin & Hedell, 2013). We performed the coding during a brief time in February-March 2017.[7] This short time span adds to our recognition of the weakness in the method(s) used.

The datasheet with the coding results is available on request from us, but not included in this paper, due to the integrity of our former students. Our analysis of the coding results is reported below.

Interviews

In this section we summarise the findings obtained while interviewing faculty members at the Ergonomics division at KTH.

We have been involved in the planning and development of a project course of 15 ECTS-credits in the Ergonomics master program for the last seven years. The course consists mainly of three different reports to be written: information literacy report, planning report and method report. The information literacy content of the project course corresponds to approximately 5 credits.

During the years, we have together with faculty re-designed the pedagogics on the course. We have shifted from a lecture-based approach towards a lab- and seminar-oriented approach, a shift based on blended learning research and flipped classroom techniques. We have also used a "micro"-version of an information literacy MOOC-styled module as a net-based learning support, a module which was developed in 2013.[8] We have also tried to connect all teaching activities to facilitate the students' future work, both in their thesis writing and working practice. For that, the Ergonomics faculty supplies the project course with seminars on earlier thesis works, on practitioner-based studies in Ergonomics and on current research projects at the department.

Our subjective evaluation of the re-design has been an improved student performance, both in quality and in the time spent by students completing the information literacy part of the

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[7] This choice was made due to a lack of resources available for research work during the Autumn 2016 semester.

[8] The module, called "KTHBx", was developed by my former colleagues Bengt Haraldsson and Thomas Nyström.

course. We have also seen a decrease in the total number of teacher hours allocated to each student. To investigate further, we interviewed two members of the Ergonomics faculty during the academic year 2016/2017, Dr. Andrea Eriksson (AE, course responsible teacher for the project course since 2015) and Prof. Jörgen Eklund (JE, Head of the Ergonomics department since 2009 and earlier at Linköping University).

JE reports on the differences between the Ergonomics master program in Linköping compared to KTH. On major difference is that Linköping required the degree project to be 30 credits, while KTH requires the magister degree project to be 15 credits. Hence the project course of 15 credits was developed. The underlying idea behind the course was the following. In Linköping JE had a regular "degree project course" containing seminars on research skills, for example how to search, read and evaluate scientific literature. Since the magister degree project at KTH is only 15 credits, the degree course had to be shortened without shortening the degree project works, and hence they needed to compensate for the lack of research skills seminars in the curriculum. The project course should cover that, together with giving the students an introduction to general project organization skills and current research areas and developments projects in Ergonomics and HTO.

The reason behind introducing students to current areas of Ergonomics is the following. In Linköping, some of the students took until the last semester to start contact external organizations for project works. This led to some students being slow to complete, if ever, their degrees. By introducing the students earlier to the field of Ergonomics, and encouraging students to make earlier contacts, the completion rate (and speed) could be improved (Eklund, 2017).

AE reports the following curriculum development in the project course:

"I have developed the following content:

• Early introduction to ongoing research/researchers at the unit of Ergonomics:

Aim: To give an early introduction to what ergonomic research could be so that the students get inspiration for their master thesis. Early connections to potential supervisors

• Seminars/lectures on how do project work within the field of Ergonomics

Aim: Exploring hindrances/possi[bi]lities in doing ergonomic research/project work/master thesis? Important planning steps to think of in general project work.

• A seminar on how to interpret the criteria for writing a master thesis

Aim: Within the course we have a seminar called "Examinations criteria". The assignment of the students is to read two selected master theses in the light of the master programs specified examination criteria. The assignment connected to the seminar is to analyse and discuss how well they think the selected theses fulfil the criteria. The seminar is held by me (course leader) together with one of our examiner (possible but not necessary examiner of the students at the seminar).

• Instructions, processes and content of seminars connected to the student's project plans and method reports (preparatory for master thesis)

Aim: Development of clear instructions for each task. Individual follow up of progress of each individual student. Individual coaching if needed.

My focus has been how we can support students to more timely finalize their master thesis. This includes both to decrease drop outs, i.e. those who never come to finalize their thesis work at all, as well as supporting students to finalize a thesis with good quality within the semester allocated for the work." (Eriksson, 2017a)

The aim to make the students finalise their thesis work correlates with the observation from Linköping that this was a problem. Partly this was (and is) because many of the students are of a somewhat older age where they have many other obligations in life: they are working, they have a family, etc. These are things that affect the amount of time they allocate for studies and perhaps lessen their motivation for getting a degree. JE mentions instances where students wanted to broaden and deepen their knowledge first and foremost, without completing a degree project.

A change in the program which came with the move to KTH was the possibility to follow the program in full pace or in half pace. This seems to have attracted a larger portion of younger students, which we believe can have better opportunities to put in the necessary study hours. Generally we believe that the information literacy skills in master students are better the more recent they completed their bachelor degrees.

The third bullet point above is the seminar introduced by AE on how to interpret the master program examination criteria. This can be seen as a reaction to the increasing demands on academic content in the degree projects. (As a side note, the UKÄ Swedish Higher Education Authority has evaluated the master program and already found it to be of high quality.) We think that this peer-assessment-inspired seminar is strengthening both the constructive alignment of the course and the acceptance among students for the necessity of putting their work into an academic context. This in turn may have resulted in greater efforts by the students to work on their literature studies and their information literacy skills.

AE also emphasise the fact that the students now use focus upon using *scientific* sources as basis for their literature studies, which she thinks is a difference from earlier years. This observation coincides with my observation from the coding, that the students rely to a much larger extent on non-scientific sources in the theses from Linköping (and from 2010-2011 at KTH) than in the newer theses at KTH. In particular, I viewed and documented a selection of reference lists from the Linköping master theses in which the majority of references listed was to non-scientific material.[9] These observations do not constitute a proof of increased information literacy skills in student over time, but it is an independent valuable observation.

But AE cannot judge whether the information literacy skills have developed over time. She gives time pressured students (compare above) as one explanation. However, her subjective view is that the bar has been raised; the lowest quality has been raised to medium: "I think that it previously was more common to find examples of master thesis that were more 'reports' with limited theoretical/scientific connections." (Eriksson, 2017a)

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[9] It is not self-evident what constitutes the distinction between "scientific" and "non-scientific" material, of course.

The other three of AE's bullet points above all deal with the "finalizing" problem. Neither AE nor JE can provide statistics on the effect of the pedagogical changes, but JE mentions one improvement. Given that the project course requires a planning report on the future master project to be completed during the Autumn semester, then the students are ready to start their master project at the beginning of the Spring semester, since they have already contacted companies, considered plausibility of study design, etc. And additionally, if there is problem during the master project which requires the student to change project topic, then the student is faster to re-design their project and make a new project plan, thus in turn increasing the chance of a completion of the master course on time.

Last of all, we have personally from the KTH Library seen an increase in faculty-librarian collaboration over time during the years 2009-2016. To some extent we have increased the teaching hours from the KTH Library, from a one-shot seminar in 2009-2010 to being responsible for the teaching and the examination of 5 credits (2012-2016).

But viewing this ideologically, this is not the most important change we have done. We have aimed to foster and improve a *community of inquiry* via a blended learning approach (Vaughan, Cleveland-Innes, & Garrison, 2013), with the extra challenge that we do it in a distance-based educational program. We have by strategic and pedagogic developments tried to increase the *cognitive and teaching presence* in the course. Details on this development work have been reported in (Androls, Lucassi, & Wallén, 2015).

Results and discussion

Two findings from the coding are worthy of special mention. First, there is an increase over time of the citation/reference-instances used for critical evaluation or to introduce different or contrasting views. This can be seen as an increased awareness in the students of the fact that sources must be critically evaluated and that is important to take into account different viewpoints on a scientific problem, not only those that support one's own work. However, the increase is weak. Moreover, the total occurrence of references with critical evaluations and contrasting opinions is low; if we also take thesis length (in page numbers) into account the relative increase is even weaker. During the conversation with AE we both identified this as an area of improvement in future development work for future courses and the new two-year master program, scheduled to be started in academic year 2018/2019 (Eriksson, 2017b).

Second, there is an increase in the ratio c_1/c_2 over time. This we interpret as that the newer students more often use sources to strengthen their statements and arguments made, rather to use earlier published material just for reporting facts. This can to some extent be seen as sign of information literacy or that references made are qualitatively higher on average. Please note here that we focus on the ratio c_1/c_2, rather than absolute numbers c_1 and c_2 individually, since we want to adjust to different in thesis works of different sizes.

However, the (possible) improvement in information literacy must also be attributed to external factor influencing the educational programs, such as differences in the aims and objectives for the educational programs at Linköping and at KTH over time. The improved coordination between teaching and administrative staff at KTH may also have had a positive effect on the learning process for students.

Correlating these findings with the survey results in (Göran Hamrin, 2016), there can be seen an excellent opportunity to improve the information literacy teaching activities provided by

Swedish technical university libraries for master students and their degree project works. This holds, since there are currently few examples of well-structured and coordinated information literacy teaching for Swedish engineering students in the thesis writing process.

Concluding remarks

The research approach to use an interpretative content analysis on a set of master theses to investigate the impact of our increased integrated information literacy teaching activities was productive. The analysis indicates that the increased presence of integrated information literacy teaching activities, together with a curriculum development made by the Ergonomics faculty, has led to improved master theses at KTH. We therefore claim that there is an increase in information literacy skills over time in students who completed the master degree in Ergonomics. But there is clearly a need for further studies, before a final conclusion and further recommendations can be made.

Future research plans: A statistical analysis on possible correlations between the frequency in different use cases of references and the ECTS-grade awarded to the theses would be interesting. Since it is practically impossible to scale up the interpretative content analysis to large sets, we are planning to use an automated approach via cluster analysis, neural networks and language analysing tools for automatic classification of thesis works in our future work.

Moreover, given the fact that the KTH Library offer teaching in a flipped classroom blended learning approach for a distance-based master program, it would be valuable to see whether the same approach would be fruitful for a campus-based master program. And naturally, we have thought of a multiple of alternative teaching designs (including an open MOOC-module in information literacy to be provided for use directly by KTH faculty in their courses), which we would like to test in similar settings.

Acknowledgements

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Appendix A: List of coded master theses in Ergonomics at KTH 2010-2016

1   K. Aili, "Med uppstyckat arbete : En studie som mäter stress bland ackords- och linjestyckare", 2010.

2   A.-L. Allert, "Att mäta lean-utveckling : En sammanställning av metoder för att mäta utveckling inom lean och en fallstudie på ett företag", 2011.

3   S. Bergkvist, "Ergonomiskt burklock : En produktutvecklingsprocess av skruvlock för glasburkar", 2010.

4   M. Bergstrand, "Styckares arbetsmiljö : En studie om knivskärpa, olika knivstålskvaliteter, arbetssätt, samt fysisk ansträngning", 2011.

5   I. Bodin, "Using cognitive work analysis to identify opportunities for enhancing human-heavy vehicle system performance", 2013.

6   M. Carlström, "Design for human behaviour and automation : Development and evaluation of a holistic warning approach", 2014.

7   M. Dahl and C. Ekholm, "Konsekvenser av ny teknik på en sjukhusmottagning", 2013.

8   R. Eklund, " Presentation av taktisk information på bildskärm: Head-Up Display som stöd för tidsstyrd taxning med flygplan", 2012.

9   L. Englund-Lehmann, "Validitet och reliabilitet av ett arbetsbelastningsindex (ai) i en fhv enkät", 2014.

10   A. Groth and S. Uddholm, "En studie av fysiska, organisatoriska och individuella riskfaktorer hos arbetstagare med datorarbete", 2012.

11   A.-B. Gunnarsson and M. Wersäll, "Hand arm riskbedömningsmetod (harm) : Utvärdering av en metod för riskbedömning av biomekanisk belastning av övre extremiteten vid manuellt arbete samt dess lämplighet vid arbetsmiljötillsyn", 2011.

12   J. Henriksson, "Support systems for material handling in forklifts", 2014.

13   J. Holmström, "Smitthantering i vården : En fallstudie om patientsäkerhet på ett svenskt sjukhus", 2013.

14   E. Jaldestad and I. Hansson, "Chefsutbildning i psykosocial arbetsmiljörond : Utvärdering av en utbildningsinsats inom primär stressprevention", 2015.

15   C. Karlsson, "Samband mellan transportsätt vid hembesök och belastningsbesvär hos personal inom hemtjänst och hemsjukvård", 2010.

16   L. Tängerstad and M. Källskog, "Finns det arbetsmiljöfaktorer på arbetsförmedlingen kundtjänst som förklarar korttidssjukfrånvaron? - en studie med mto-perspektiv", 2014.

17   C. Kårebrand and D. Grundström, "Upplevd resiliens i två högriskorganisationer", 2015.

18   I. Larsson, "God kvalitet på skyddsrondsarbetet inom byggindustrin : Framgångsfaktorer och utmaningar", 2016.

19   C. Lind and E. Werdler, "Händerna på monteringen : Ergonomiska effekter av ett förändrat arbetsupplägg", 2010.

20   M. Löfstedt, "Rehabkoordinator i primärvården inom region gotland : För en förbättrad sjukskrivningsprocess", 2011.

21   M. Müller, "Ohs practitioners' application of cad-tools as medium for participatory design : Facilitating the projection of office-layouts", 2015.

22   J. Nordström, "Ett mto-perspektiv på rökdykning : Arbetsuppgiften, tillbud och olyckor", 2015.

23   S. Nyman and M. Fälteke, "Utvärdering av en inskrivningsprocess : Hur fungerar interaktionen mellan sjuksköterskor, journalsystem och arbetsorganisation", 2016.

24   O. Ogén, "Från organisationsteori till mto-analys? : -en fallstudie om fyra chefers arbetssituation", 2011.

25   C. Sandberg, ""vård i annans hem" - användning av arbetsmaterialet i huddinge kommuns hemtjänst/boendestöd och personlig assistans", 2012.

26   T. Vaara, "Tillbudsrapportering : Ett kognitivt dilemma eller en praktisk svårighet", 2012.

27   R. Wiik, "Stöd av kommunikation inom distansguidning av ercp : Applicering av ett mto-perspektiv tillsammans med ett tjänstedesignsverktyg", 2016.