

How to write a Master's thesis – A learning pathway written report skills at the Faculty of Engineering Science at KU Leuven

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ABSTRACT

This paper describes the learning pathway written report skills at the Faculty of Engineering Science at KU Leuven. First, the state of affairs of written report skills that Bachelor's graduates should have obtained during the curriculum is explained. The next section outlines the position of the Master's thesis in the engineering curriculum. Furthermore, the three workshops organized by the Faculty are illustrated. Likewise, the Teaching Assistants also get a training to guide the Master's thesis. Finally, conclusions, discussions and future work is outlined.

The Master's thesis is considered as an essential part of the academically oriented engineering program. It gives the students the opportunity to show both their competences to do scientific research as well as to report their results.

The learning pathway is designed within the structure of a five-year engineering program, containing two Bachelor's programs and fourteen Master's programs, with more than 3,000 students enrolled. The focus of this paper lays on the last phase of the learning pathway when students are asked to report on their research by writing a Master's thesis.

There is a slight overlap with the learning pathway Problem-solving and Design, where students work in groups of up to eight persons. One of the aspects of the Problem-solving and Design courses is the research report.

The faculty organizes three workshops, aimed at guiding the students, convincing them that not only the research forms an important part of the course. The first workshop, Information Literacy, is organized in corporation with the Campus Library. During a two-hour session, students are encouraged in an interactive way to explore their Master's thesis topic and to try to find references. The second workshop, Intellectual Integrity and Plagiarism, lays focus on the ethical side of plagiarism and why you should quote or refer. The third Master's thesis workshop, Academic Writing, emphasizes two aspects of the Master's thesis: an academic writing style and the structure of the Master's thesis.

The role of the Master's thesis advisor and mentor must not be neglected. Therefore, the Faculty of Engineering Science provides a workshop during the Starters Week of Engineering and Education: Training for TAs (SWEET²). The Teaching Assistants receive information about guiding a Master's thesis and giving feedback on the written reports of their students.

The main aim of the learning pathway written report skills is to provide students with decent working tools and guidance throughout the whole Master's thesis project. In bringing together all the efforts throughout the whole curriculum, academic success should improve.

Keywords: written report skills, learning pathway, didactic training, master's thesis

INTRODUCTION

At KU Leuven in general, and at the Faculty of Engineering Science in particular, a Master's thesis forms the closure piece of a five-year program. Students do not only perform research on a program-related topic, but also have to communicate in an oral and/or written way about the performed research.

Worldwide ongoing research shows that incoming engineering students are attracted to an engineering education because of the emphasis on sciences, technology, mathematics, problem-solving and research [1]. Gaps, arisen from the emphasis on knowledge acquisition, are identified, one of them covering the written and spoken communication [2]. Although communication courses do not make the same, self-evident claims on engineering curricula as technical or scientific subjects do, they are essential for a 21st century engineer who aspires to carry out a professional practice in the global area.[1, 3-5].

Furthermore, writing publications make a major part of the workload of engineering academics, not to mention any grant applications or research proposals. Due to this, there is an imperative for engineering academics to see writing and communication as part of what they do and therefore part of what they should teach, resulting in the development of writing capabilities of the engineering student [2].

At the Faculty of Engineering Science, the educational project RAPPING (reporting in engineering science) was set up by educational developers to integrate written and verbal skills across the engineering curriculum [6, 7]. This educational project got translated into a learning pathway (Written) Report Skills, covering the two Bachelor's, twenty-three Master's and six Advanced Master's programs, with in total over 3,000 students.

This paper elaborates on the last stage of the learning pathway: the Master's thesis, a research project or dissertation in which the students show whether they have acquired the appropriate academic competences to contribute independently to scientific research and development, as well as to report their results. First, the state of affairs of written report skills Bachelor's students should have obtained during their three-year program is given. The next section outlines the position of the Master's thesis in the engineering curriculum. Furthermore, three workshops, entitled Information Literacy, Intellectual Integrity and Plagiarism, and Academic Writing, organized by the Faculty of Engineering Science in order to guide the Master's student in his writing and researching project are illustrated. Likewise, the teaching assistants, PhD students with a teaching assignment, also get a

training in guiding Master's theses. Finally, conclusions, discussions and future work are outlined.

WRITTEN REPORT SKILLS – BACHELOR'S

The learning pathway (Written) Report Skills shows an overlap with the learning pathway Problem-solving and Design (PS&D) [8]. The PS&D-courses constitute an important learning pathway in all programs and are spread over five of the six semesters of the Bachelor's program. These PS&D courses translate the vision of the Faculty of Engineering Science to form engineers from day one. The learning pathway PS&D is based on the design pyramids shown in Figure 1 [9].

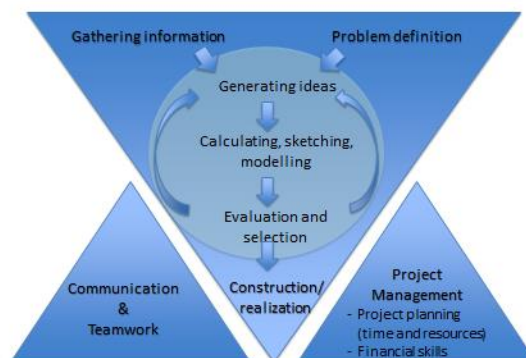


Figure 1. The design pyramids of Problem-solving and Design at the Faculty of Engineering Science.

Written report skills are situated in the left pyramid. One of the objectives of the courses PS&D is 'gaining communication skills: writing technical reports' [8]. However, it is difficult to ensure that each individual student learns the skills of written communication due to the team-based assignments. Typically, each student writes a portion of the report but this does not mean that all students contribute equally to each assignment [6]. The benefits of a group assignment are nonetheless vital in modern higher education. Students learn more when they get reviewed by peers [10]. Studies of interactive communication among learners, peers and non-peers prove that by encouraging students in taking responsibility for their own learning, undergraduates improved their skill regarding problem-solving as well as their ability in written, oral and graphical communication by talking or writing about their research [11].

The PS&D courses increase gradually in complexity. As a consequence the written report skills also need to be further extended. In the PS&D course of the first semester, incoming students learn to execute a literature study. One of the main objectives of this course is to reference correctly and to get acquainted with intellectual integrity.

An instruction seminar, followed by some exercises and a guest lecture of a linguist, take place as part of the PS&D3 course. Students have to write a report in groups from six to eight

persons. In order to prepare for the seminar, the students are expected to have started writing, or at least to have set up a structure. The seminar is given by several professors of the Faculty, supported by educational developers. The first part of the seminar focuses on the macrostructure of a report, e.g. table of contents, introduction, corpus, and conclusions. The focus of the second part switches to the microstructure and is given by a linguist of the Institute of Living Languages (ILT) of KU Leuven. The students learn how to be concise, how and when to use signal words, how to avoid the passive voice, and learn about punctuation. After following the seminar, the students receive a manual on reporting skills, developed during the RAPPING project, which remains an important reference work for the next years of their university career [12].

WRITTEN REPORT SKILLS – MASTER’S

After obtaining a Bachelor’s degree, students enroll in a Master’s program mostly corresponding to their combination of major and minor. On that account, the largest part of the Master’s students exists of students who are familiar with the Faculty’s customs and traditions, and who successfully passed the Problem-solving and Design courses. Lateral-entry students need to follow a small preparatory program. The same goes for foreign students.

The learning pathway (Written) Report Skills ends with the Master’s thesis. Each Master’s program consists of two years, each of 60 credits, of which 24 credits belong to the Master’s thesis. The preparations for the Master’s thesis already start in the spring semester of the first stage when possible topics are announced. During this semester, students are encouraged to contact researchers and associated professors within the program, although conducting a Master’s thesis in industry, or abroad, is also possible. The actual research and writing process itself is executed in the student’s second master year.

The learning outcomes of the Master’s thesis, in perspective to the learning pathway (Written) Report Skills are threefold. The student (1) should formulate the research question clearly and correctly; (2) should be able to report about his research in a coherent way, where adequate attention is given to correctness of the displayed information, understandable and clear within the discipline, scientific language, correct Dutch or English, and the layout of the text, references, tables and figures that meet the specified formal requirements; and (3) should have an academically correct attitude in relation to references.

In order to obtain these learning outcomes and to complete the Master’s thesis, the Faculty of Engineering Science organizes three open workshops for Master’s thesis students and one mandatory training for the Teaching Assistants on guiding a Master’s thesis.

WORKSHOPS

According to Lievens’ research (2012), engineering students feel that their innate, core competences lie elsewhere than with writing, but they also feel that writing skills, and communication skills in general, are of only tangential importance for their later careers [1]. On the contrary, writing practices are intrinsic to the

engineering practice and are identified by different studies as a key competency, even for the 21st century engineering [14]. Given this importance, it should become a visible and integral element of the engineering curriculum [15].

In order to make the learning pathway Written Report Skills more visible, the Faculty organizes three open workshops. These workshops are not mandatory, because in line of the learner-centered approach, responsibility lies with the student. Consequently, the motivated students show up. Table 1 illustrates the amount of students registered in 2015.

Information Literacy	196
Intellectual Integrity and Plagiarism	216
Academic Writing (Dutch)	167
Academic Writing (English)	49

Table 1. Master’s Thesis Workshops: registered students (2015)

The three workshops are organized during the fall semester. In the first weeks of the new academic year, students can enroll for all the sessions. The workshop Information Literacy takes place in October, while the workshops Intellectual Integrity and Plagiarism, and Academic Writing are offered mid-November, on the same evening.

Information Literacy

In order to create a more cohesive and integrated approach to information and knowledge synthesis, academic advisors, educational developers and librarians need to collaborate in different areas [16]. One of those areas is the teaching of information literacy. Librarians have found that the best way to teach information literacy is through embedding the relevant skills within the units of study, rather than teaching generic skills in library workshops [16]. In this respect, the workshop of Information Literacy is embedded into the Master’s thesis and is organized in corporation with the Campus Library Arenberg (CBA).

Students mention their Master’s thesis subject at enrolment, in order to provide a workshop that is closely linked to their interests. The workshop first explains where in the CBA students can find books about Master’s thesis writing and Information Literacy. Secondly, the use of keywords is discussed. Students become aware of different techniques in order to find the most correct and useful information: e.g. use of synonyms and translations, Boolean operators, truncation, etc. The next step is to gather information. Students learn to work with databases such as Limo at KU Leuven and citation indices such as Web of Science. After the information gathering, the structuring and managing of the search results and references follow. Different reference management software is explained. Online tutorials are provided for the use of Zotero, Mendeley and EndNote. These online tutorials are also provided via the students’ portal of the Faculty’s website.

This workshop ends with a short introduction to the workshop of Intellectual Integrity and Plagiarism.

Intellectual Integrity and Plagiarism

Each year, KU Leuven emphasizes a certain educational topic on which the different faculties should work. The topic of the current year 2015-2016 is plagiarism. The Faculty of Engineering Science is currently developing a learning pathway plagiarism, using the newly definition of plagiarism at the KU Leuven, the already-existing workshop on plagiarism and on information literacy, and newly initiatives in the various programs such as an integrity code.

The workshop outlines not the consequences of plagiarism at the university, or how the Faculty controls submitted Master's theses on plagiarism, but attempt to explain intellectual integrity. During the workshop, different examples of resignations of ministers and academics are mentioned, some more recent as for the German minister Karl-Theodor zu Guttenberg, some in history as was the case with Isaac Newton and Gottfried Wilhelm von Leibniz and the invention of calculus. These examples illustrate the different perceptions of plagiarism during history.

The workshop concludes with other forms of intellectual fraud, the use of the internet and the use of references, with "be consist" as the most important rule.

Academic Writing

A workshop on Academic Writing, situated in the last year of the engineering curricula, seems a bit odd, because at this point students should already know how to write. Academic writing however is governed by rules and practices that adhere to traditional conventions [16]. In order to deliver a high-quality Master's thesis, it is useful to refresh previous achieved writing skills and KU Leuven conventions in one coherent session.

This workshop takes place in the middle of the fall semester. At this point, some students will have started writing, others still think they have more than enough time left. This causes a different state-of-affairs and leads to an interactive session where best practices are exchanged. The session is based upon three manuals, one of them provided by KU Leuven's own ILT [17-19].

The Academic Writing workshop is given in an English-language and a Dutch-language version. Some Dutch-language students prefer to write their Master's thesis in English to reach a more global audience. These students joined the English-language version. English remains the lingua franca between professionals internationally [4].

The session is divided into three large parts, besides the introduction: macrostructure, microstructure and writing and spelling tips. Firstly, the macrostructure of a text aims at the different parts of an academic paper, such as table of contents, abstract, corpus, conclusion, etc. Each of those parts is outlined, with some good and less good examples. Secondly microstructure handles the lay-out of the text, in order to make the Master's thesis more readable, by using subsections, paragraphs and signal words. Finally, the writing and spelling

tips contain common mistakes, constructions that should be avoided like colloquialisms, informality, vagueness and the passive voice, and punctuation. The sessions closes with one advice: learn, gain insights by (re-)write [10].

GUIDANCE OF THE MASTER'S THESIS

Each Master's thesis student is coached by a teaching assistant (TA), mostly a PhD student with a teaching assignment, who is closely connected to the Master's thesis topic. Within the SWEET²-module 'How to guide a Master's thesis', the importance of clear agreements is highlighted and the TAs receive tips and tricks, how they can guide the student. In accordance with the 'teach as you preach' principle, the teaching formats refer to the one-to-one relationship of the TA with the student. During a roleplay for example, cases are given and the participants should react as a TA or a student.

The importance of well-educated lecturers may not be underestimated. The Faculty of Engineering Science attaches great importance to the role of the TAs. These TAs coach PS&D projects, give exercise sessions and guide Master's theses. Since many TAs struggle with their teaching assignments, the Faculty of Engineering Science introduced an educational training program for PhD students in 2005. In 2013 it got renewed during the PRIMA project (Professionalization in Engineering Science: the Millennium Assistant). As a result of this project, the educational training program has evolved into SWEET² or Starters Week of Engineering and Education Training for TAs [20].

Twice a year at the beginning of a semester, the Faculty organizes a SWEET²-week, where three modules are taught. PhD students should, in order to graduate, follow at least one module, consisting of a preliminary assignment, a start session, an intermediate assignment and a follow-up session. It takes two SWEET²-weeks to complete the module. Besides, the structure of the module corresponds to the various moments during the academic year when Master's students are guided, like defining the subject, getting started and the process during the year when feedback should be given. [21]

CONCLUSIONS AND FUTURE PLANS

Writing a Master's thesis, seems a challenge for engineering students worldwide. The Faculty of Engineering Science gives its students the necessary tools in attempt of tackling this challenge. From the first Bachelor's year till their Master's thesis, students learn in several sessions how to academic write a paper and how to search for and refer to information. From the side of guiding a Master's thesis student, TAs receive a professionalized training during one of the two SWEET²-weeks each academic year.

The Faculty needs evaluates, steers, updates and implements the learning pathway (Written) report skills continuously. In the near future, the Faculty will provide all the students, professors and TAs with some guidelines on writing a Master's thesis. Besides, the Faculty will review its feedback formulars. The newly developed learning pathway plagiarism will be integrated in the learning pathway (Written) report skills. A first step, already

taken, is to map the current achievements in the Bachelor's programs on plagiarism and information literacy, mostly during the P&O-courses.

The learning pathway (Written) report skills is one way of overcoming the stereotypical ideas about engineering students, one step closer in delivering multidisciplinary 21st century engineers who can conduct research and report on it.

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