A ROAD TOWARDS A BETTER WRITING

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ABSTRACT

Writing is used as primary activity within most of the master programs within Civil Engineering education to support the students to reach a significant number of learning outcomes in different courses. However, none of these activities address writing itself even less how it must be performed, so it is a demand to the students to write and critically review technical reports in many occasions without giving proper tools on how to do it. That has raised some concerns among teachers involved in the program. A more generalized problem that affects students across the entire master program is that many of them reach the final master thesis report with clear writing difficulties. In this paper, therefore, it is present a proposal on how to address the writing by introducing new Teaching/Learning Activities (TLAs), Intended Learning Outcomes (ILOs) and Assessment Activities (AAs) transversally through the master program. Consequently, some courses within the MPSEB has been selected and modified accordingly.

KEYWORDS: constructive alignment, writing development.

1. Introduction

The Master Program in Structural Engineering and Building technology (MPSEB) [1] at Chalmers University of Technology [2], promotes the development of knowledge and skills needed for designing and operating of structures and buildings about the needs of a modern, sustainable and resource efficient society. Essential aspects are health and safety of people, human comfort, efficient use of materials and energy, service life design, and durability. The content reflects conceptualization and design of new structures and buildings, as well as maintenance and assessment of existing ones. Furthermore, a good overview of the field, ability to co-operate with others, to communicate in an international environment, and to lead project works are required. The program promotes personal development of knowledge, skills and attitudes that are needed to start working as a professional engineer in the field of structural engineering and/or building technology. In the program, approximately 20 % of the students are international students.

Today, it is possible to find writing activities in the majority of the courses within the MPSEB, which support the matching of the different learning outcomes in different ways. However, none of these activities address writing itself even less how it must be performed; so, it is a demand to the students to write and critically review technical reports in many occasions without giving proper tools on how to do it. That has raised some concerns among the teachers involved in the program. To improve the courses and the achievement of the different learning outcomes, the students need to have support for how to structure a report, such as how to write an introduction, how to describe a technical problem, and how to structure their results and conclusions. Furthermore, students must

be able to work with the feedback they have got [3]. Currently, students will get the feedback at the end of the courses, and they do not have to respond to it. This may lead to that the students will not gain any knowledge for the given feedback that teachers had spent many hours to give.

A more generalized problem that affects students across the entire master program is that many of them reach the final master thesis report with significant **writing difficulties**. Although some of these difficulties may be attributed to an inadequate language proficiency levels, which could be potentially reduced by implementing more rigorous requirements to access the master programs at Chalmers, other difficulties are attributable to a lack of familiarity with the formal aspects of technical communication, which discloses an important deficiency in the current teaching model within the master program.

In this paper, therefore, we present a proposal on how to address the writing development of the student by introducing new Teaching/Learning Activities (TLAs), Intended Learning Outcomes (ILOs) and Assessment Activities (AAs) focused primarily on how to improve writing, transversally through the master program. Consequently, some courses within the MPSEB have been selected and modified accordingly.

2. The structure of the MPSEB program

The plan for MPSEB is shown in Figure 1. It consists of an introductory part ‘overview and basics', a fundamental part ‘technical knowledge and tools' and a final part 'deepening and synthesis’.

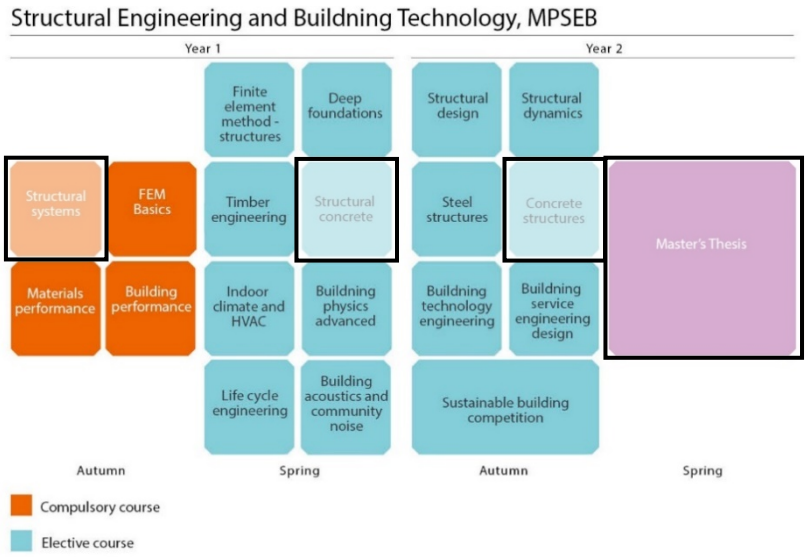

Figure 1: Program plan for MPSEB. Highlighted courses affected by the project.

The introductory part is compulsory and provides a comprehensive view of complex buildings and structural systems and processes for planning, designing, construction and operation. After the introductory part, the student can choose to specialise towards ‘*Structural engineering*’ or ‘*Building technology*’ where the fundamental part provides the core engineering knowledge and tools for problem solving. The student who prefers more general competencies in structural engineering and building technology can combine courses from the two branches.

The branch ‘*Structural engineering*’ provides specialist training for students aiming at design and analysis of advanced structures for various applications, such as buildings, bridges, and offshore structures. It covers structural design from conceptual design to detailing, and structural modelling and analysis of new as well as existing structures. The branch ‘*Building technology*’ provides

specialist training for students aiming at design and analysis of complex building systems, especially concerning thermal performance, indoor climate, and efficient use of energy. It covers the design of resource efficient buildings from the conceptual stage to detailing, and modelling and analysis of systems and components of both new and existing buildings.

The final part encompasses the MSc thesis project, in where the student should demonstrate ability to plan and carry out qualified tasks within given constraints, and personal and professional skills in advanced problem solving, knowledge discovery and development, and systems thinking. Furthermore, the results and conclusions should be communicated in a thesis as well as orally.

2.1. **Courses affected by the project**

In the writing development progression, three courses and the concluding MSc thesis project have been designed. Two of the courses, *'Structural systems'* and *'Structural concrete'* are first year courses. The third course, *'Concrete structures'*, is the last course prior to the MSc project.

2.1.1. *Structural systems*

"*Structural systems – design and assessment*" [4] has a unique role to encourage further development of skills in problem solving, system thinking, team work and communication. The course presents how to carry out designs in a service life perspective, which means that the course also provides understanding of the complete process from conceptualisation, design and construction to operation, maintenance and assessment of existing structures. In this course, the students start to work together in international teams, learn to get to know each other and share information and experiences. Supervision is given by practicing engineers and the students have the opportunity to visit the engineers at their respective design offices.

General structure of the course

The main objective of the course is to promote the development of an holistic view regarding the design and assessment of structural systems and their components. A secondary aim of the course is to function as an introductory course that unifies the group of students in terms of their background knowledge to achieve a common set of prerequisites for following courses.

TLAs in the course consist of a collection of lectures where different speakers introduce and share their personal experience with the students on various topics needed for the project assignment. In addition, the students have the opportunity to participate in two study visits, which contribute to a better understanding of the different concepts. Finally, a major project assignment constitutes the main part of the course's work load and consequently of the final grade. The project is carried out in groups of between four and six students. The main task of the project concerns the conceptual design of a real building structure under the supervision of a practicing engineer. The conceptual design is divided into two well-separated parts: first the design or creative part, where the students need to identify and describe the main boundary conditions of their case study, they need to train their critical thinking to come up with alternative solutions that can solve the identified problem from different perspectives, revise them and evaluate them actively applying the concepts learnt during the introductory lectures. The second part seeks to further develop the suggested alternatives to reach a final solution, carry out the preliminary sizing of the main elements and perform a risk analysis, all of which must be presented and defended in front of a jury at the end of the course. Moreover, the project assignment is intended to enhance the ability of the students to work in multi-disciplinary groups as well as improve their presentation skills.

Currently, the course is assessed in two different ways. The first is an individual test corresponding to 40% of the final grade that is carried out towards the middle of the course and which covers part of the course ILOs. The second way in which the achievement of the ILOs is assessed involves the evaluation of the project which is carried out at two different stages. At the end of the conceptual design phase the first part of the project is handed in in the form of a slide presentation with extended notes. The slides are then evaluated by the teachers and feedback is provided to the students before they move on to the second part of the project. The second evaluation takes place, as a group, by means of an oral presentation and a written report based, primarily, on the slides of the oral presentation complemented with comments. This represents the remaining 60% of the final grade.

2.1.2. *Structural concrete*

The ***"Structural concrete"*** [5] course is of complementary nature and completes the basic knowledge of plain and reinforced concrete. The main aim is to promote development of the ability to analyse and design reinforced concrete slabs, plates and discontinuity regions, and structural members of prestressed concrete. The assessment activities in the course consist of a FEM project, an individual test, and an individual final exam. TLAs in the course consist of lectures and exercises on slabs, discontinuity regions, and prestressed concrete members. In addition, there is a computer lab in which designs of a reinforced concrete slab are performed using linear FEM; and the software Abaqus CAE [6] is used. The ILOs related to the theoretical parts of the course - describe and explain the structural behaviour of slabs, discontinuity regions and pre-stressed concrete members - are tested in the individual test. In the final exam, the students' problem-solving skills are tested. In the FEM project, the final written report with a detailed design of a reinforced concrete slab is examined as well as a review of another group's report. The final grade in the course is based on the results of the individual test, the final exam, and the FEM project.

<u>General structure of the FEM project</u>

In the FEM project five theoretical lectures are given and nine working steps. In all the steps, measures are taken to assure quality of the students work. Furthermore, documentation of the work is done and in the end of the project, a final report is handed in, which is graded. The workings steps in the FEM project, the reinforced concrete slab: (1) to sketch a **principal load distribution** by hand, (2) to create a **structural model** of studied slab portion, (3) to create a **FE model** of the structural model, (4) to run **static linear FE** analysis, (5) to **compare** the principal **load distribution** done by hand with the FE analysis, (6) to calculate required **reinforcement moments,** (7) to **verify the FE model** and compare with strip method (hand calculations), (8) to d**esign the reinforcement** and (9) to produce a **reinforcement layout sketch.**

For the final technical report, guidelines are given. In the guidelines the format of the report is given, and the report should treat following: "Problem description", "Approximate load distribution", "Structural Model", "FE model", "Results of the FE analysis", "Strip model", "Verification of the FE model", "Design of reinforcement", "Reinforcement sketch and Conclusions". For each heading, more detailed guidelines are given as well. Additional appendices with hand calculations, result diagrams and additional computer output can be given. Finally, concluding remarks, reflections and the possibility to show insight of what the students have gained during the project work is encouraged. The final report should be critically reviewed by another group. Proposals for

improvements should be given by the 'review group' to the students who made the work and to the teachers. The final grade of the project is given by teachers in the course.

2.1.3. *Concrete structures*

"Concrete Structures" [7] is a design course of concrete structures. The goals of the course are to deliver the students a set of tools and recommendations to the advanced concrete structures design. The course consists of three compulsory elements; a FEM project, an individual test, and a final exam. TLAs in the course consist of lectures and exercises related to advanced concrete structures design and a computer lab in which designs of concrete structures are performed using non-linear FEM, by using the specific modelling FEM software **DIANA 10** [8]. The individual written examination tests the ILOs related to the theoretical parts of the course, mainly regarding basic models, structural behaviour and related phenomena. In the final exam, ILOs related to problem solving are tested. In the FEM project, the final written report is examined for the articulation of the students' level of expertise with FEM-design.

General structure of the FEM project

Figure 2 entails a scheme of the course into five blocks. First introductory sessions allow the students to gradually engage with the Finite Element tool. These kinds of tools are very new for the students and getting used to them requires a relatively large effort during the first sessions, where the mechanics, the potential and the capabilities and limitations of the tool are comprehended.

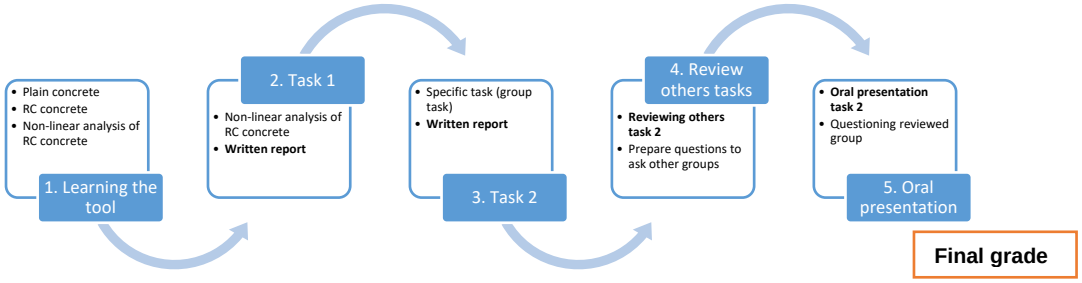

Figure 2. Organization of the "Concrete Structures" course.

All the demonstrations offered in class are also given in pdf in a leaflet format. The leaflet contains the modelling example in its three complexity degrees as well as the last part of the examples that consist of extracting and understanding the model results. Thanks to this extra material the cognitive load is reduced [9], which allows students to go back and forth in the material to check and evaluate if they have matched the modelling procedure.

Once they finish with the first block, the students in groups of four need to work with the first task, *task 1*, which ends with a hand in of technical report of the obtained results and the end of the second block. This task should not present to the students a big challenge but to provide a good understanding of the tool and results reporting. The aim with this part is that the students get a first contact with reporting results and writing technical reports from FEM modelling. This task represents the first AA of the course.

After this first hand-in, students are supposed to have matched the ILOs necessary to move to the second task, *task 2*, which ends with the block 3. This task represents the most challenging part of the course; they need to apply the technical skills developed during the learning of the tool phase in addition to the theoretical background provided in the different lectures. The last parts of the course, block 4 and 5, are connected to *task 2*. First, they need to review one other *task 2* from another group. In this peer review process, it is mandatory to come up with questions that they need to ask to the reviewed group during the oral presentation, which constituted the last activity and las

block in the course in the course. These two blocks also establish the latter two AAs from which together to *task 1* define the final grade of the course.

2.1.4. *MSc thesis project*

The master thesis at the end of the master program represents the biggest and most important piece of writing and as well the most challenging work in the whole educational plan. In this sense, all the TLAs of the different courses of the program should be oriented towards the students´ ability of developing and writing this work. Is in this part of their education where they must put to work all the developed skills in the different areas of expertise and apply them to create a work that must be unique, original, outstanding and done by demonstrating self-regulation and independency.

3. A road towards a better writing

As an outcome of some members at the *Structural Engineering* division working in a higher education course oriented towards writing, a problem related to the quality writing of technical reports within the master program was identified. The students are frequently required to write technical reports which form the basis for many course evaluations and are a core assessment outputs to match the different learning outcomes, but paradoxically the students are not provided with appropriate activities and resources to learn how to write correctly. The implementation of a general and transversal framework at the master program level was suggested to improve the writing skills of students using a constructive alignment prespectie [10], see Figure 3. Instead of including specifically devised writing courses, the proposed solution involved a series of minor individual tasks within certain courses throughout the program, in which the students would work with only a section of a technical report at a time. Hence, this paper presents our design for *"a road towards a better writing"* which should lead to an increased quality of the Master Theses.

The project is implemented at the master program by adapting the content of the selected courses which are considered to be adequate for covering the different ILOs, TLAs necessary for a successful implementation. Every described activity in Figure 3, which represents the different TLAs of the framework, can be considered as small project with its own ILOs, TLAs and ASs. Hence in the following, the framework is described in general terms, and in the next section, section 4, a detailed breakdown of the different activities will be presented.

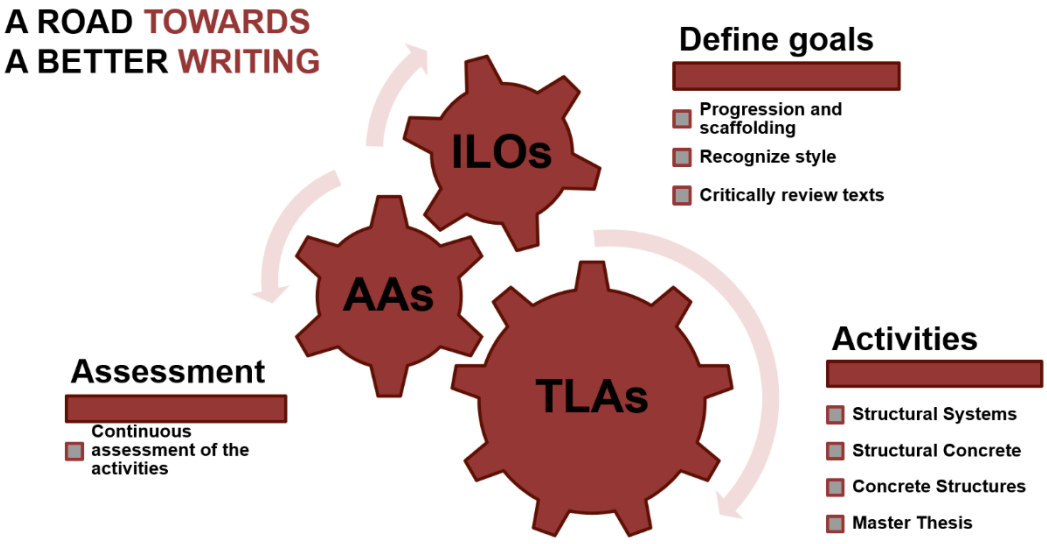

Figure 3. A road towards a better writing, constructive alignment for a better writing within MPSEB.

3.1. Intended Learning Outcomes within the proposed framework

In general, the project can be described by three main intended learning outcomes:

1. Progression and scaffolding of the writing activities in the program.
2. Recognition and identification of the style in the field, it is important to have a good understanding of the style within the field in order to produce text of good quality.
3. Critically reviewing of texts. Reviewing text is a crucial task within the technical field. Reviewing involves thinking and learning which can improve the writing skills as well.

3.2. Teaching/Learning Activities within the framework

The presented project can be understood as a holistic and transversal activity which should affect every single piece of writing along the program. However, as a first attempt for a progressive implementation the main TLAs will put the focus on some of the courses which are directly under the management of the *Structural Engineering* division, to which some of the authors of the papers belongs to. Subsequently, the first implementation of the project will be diploid in three courses and the master thesis, which will be modified and adapt to include different TLAs to scaffold the ILOs of the presented project. Figure 4 describes an overview of the different activities.

3.1. Assessment Activities within the framework

Continuous assessment of the encompassed activities is planned for the presented project. Learning through writing must be seen as relevant tool in the students' education and requires constant follow up. Hence, the project framework includes providing continuous assessment during the modified courses, which should bridge the different activities, and provide a connection between the individual projects at course level and the whole framework.

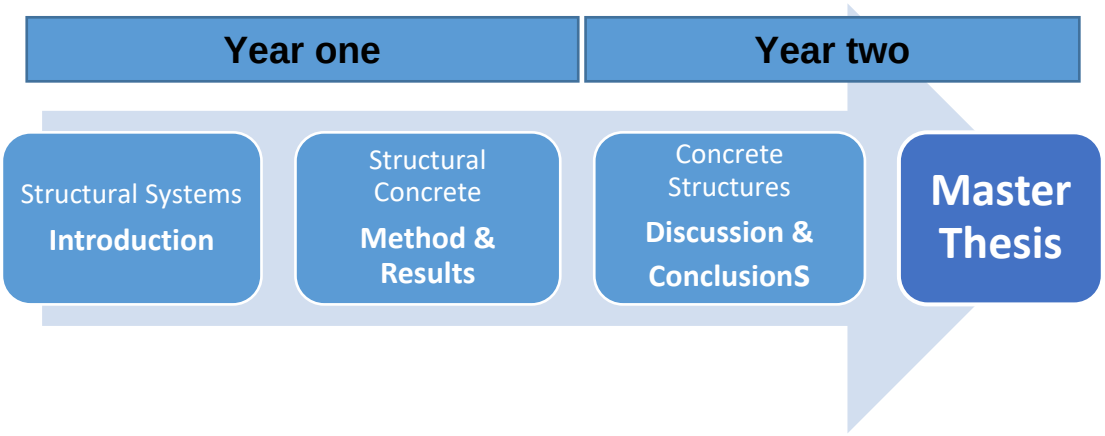

Figure 4. Activity implementation description.

4. Activity implementation

The activity implementation was developed as individual projects connected through the described framework. Every activity is scaffolded by its own ILOs and TLAs connecting to course content.

4.1. Structural systems

The course is given to a group of students with potentially very different academic and cultural backgrounds, who do not know each other and who need to cooperate through a team project to successfully meet the learning outcomes of the course. For the project assignment, this situation may very well help students to learn how to work in groups, but it also entails a certain risk of **segregation and lack of active involvement** in the project.

4.1.1. *Intended Learning Outcomes*

The main objective of the intended assignment is that students become familiar with the formal aspects of technical communication texts, particularly with the rhetorical moves used in the introduction section of articles and theses:

1. **To recognize and apply in the production of own texts the formal aspects shared by texts used for technical communication (articles, technical reports, theses, presentations). The focus is placed on the introduction part.**

The general learning outcomes of the course to which the writing will help to reach after completing the proposed assignment are the following:

2. To identify crucial aspects for the design of the assigned building with respect to structural safety and functionality requirements as well as economic, societal and environmental impact.
3. To sort the identified aspects in order of importance giving a clear motivation of the choices made to achieve a successful design that meets the client's requirements and optimizes construction time, resources employed and functionality of the building.

4.1.2. *Aligning TLAs with the course/assignment ILOs*

Two main activities will back up the presented ILOs. First, 2 hours of lecturing time related to how to write introductions will be given in order to set up the basis for the second activity which will be a structured introductory text according to the genre rules used in the academic discourse community. The course project will be used as base material for this activity, which is divided in three stages that will help the student to go through the writing process in a more structured way:

***Stage 1**: Individual work, blind peer-review, and personal learning function*

First, all students should read, the information on their respective projects. After that, they should reflect on that information and try to answer a series of questions from the perspective of the different stakeholders, namely the users, the owner, the contractor, the consultants, etc. Subsequently, the students should write a brief list describing 3 to 5 crucial aspects and stating why they are critical for the building design and send it to the teacher. At this point, the writing should be quick and at a personal learning function level.

The teacher will distribute the received texts among the group members for blind peer feedback. Then, each member of the group should put together all the different aspects from each participant, sort them in order of relevance, and write a short summary motivating the choice of the three most relevant aspects. This will be sent back to the teacher who will then put all the summaries together and redistribute them to all the members of the group.

***Stage 2**: Collaborative work in groups, individual feedback, intermediate learning function*

The next activity could be carried out together with the initial workshop of the course. During the workshop, all the members should meet and combine their respective choices to formulate a common list of critical aspects. Furthermore, to consolidate the team, other important aspects such as the vision and objectives of the conceptual design team, should be discussed. At this stage, they should write, an intermediate function text and send it to the assigned group supervisor. In a meeting group, the assigned group supervisor should promote discussion around the different aspects brought up during the individual work stage, and provide technical feedback based on personal experience to guide the students through the final decision process.

***Stage 3**: Individual work, graded assignment and teacher feedback, publication level text*

The students will be provided with relevant literature to establish a first contact with the genre commonly used for technical communication. Specifically, the students are expected to learn how to write an "Introduction and problem description". Therefore, the C.A.R.S model by Swales and Feak [11] could be of interest to illustrate a good way to structure an introduction. Moreover, every student will have to read and compare the introductory chapter of two different master thesis reports within the same program. The students should then identify and compare common formal aspects in the respective texts, including structure, style, rhetorical figures and linguistic features, and write a short reflection. Feedback will be provided at the end of the process; the students must take this feedback into consideration to change and improve their introduction which will be assessed and included in the final grade of the course.

4.1.3. *Assessment Activities*

The main assessment activity will be to individually assess the final generated introduction. This introduction should be the result of the different activities workshops lectures and discussion and feedback. The last assessment activity will connect to the review and evaluation of others work.

4.2. **Structural concrete**

Structural concrete is placed at the end of the first year. The target group of students is the same as for *"structural systems".* Hence, they have better knowledge of each other as they have been working in different course lead by group activities. As a difference with respect to *"structural systems"* the writing project can focus more in the writing aspects putting aside underlying purposes of integration and secondary goals related to work group and knowing to each other.

4.2.1. *Intended Learning Outcomes*

To give a frame to the writing activity it was decided to use the main group activity as a vehicle and framework. The group activity of the course has been focused on the use of Finite Element Method (FEM) modelling of concrete structures, which goes all along the course development and it finalises with a writing report. One main ILO connected to writing is added to the course:

1. **To recognize and apply in the production of own texts the formal aspects shared by texts used for technical communication (articles, technical reports, theses, presentations). The focus is placed on the method and results.**

Along these lines, the general learning outcomes of the course to which the writing will help to reach after completing the proposed assignment are the following:

2. To describe and explain effects of idealizations in FE-models in relation to the true behaviour.
3. To establish computational models for complex engineering problems, in this course using structural components such as shell and beam elements in the commercial software ABAQUS.
4. To check the reliability of the results, to extract and compute results suitable for design and to select data for visualization and report.

4.2.2. *Aligning TLAs with the course/assignment ILOs*

Again, two main activities will back up the presented ILOs. First, 2 hours of lecturing time related to how to write the method and extracting of the results parts will be given in order to set up the basis for the second activity which will be a structured introductory text according to the genre rules used in the academic discourse community. The course project will be used as base material for this

activity, which is divided in three stages that will help the student to go through the writing process in a more structured way:

***Stage 1**: Discussion of a technical report; how it should be structured*

First, all students should read few report examples with a focus on the report structure. After that, the students should reflect on that information and try to answer how a report should be structured. Subsequently, the students should structure their own report. A development, that has already been implemented in the course is that the students get a report template (similar the one they will use in writing their master thesis). Furthermore, in the guidelines to the project it is already included the basics of what the report should treat.

***Stage 2**: Discussion of how to present method and results in a technical report*

As for stage 1, the students should read a few reports and at this stage with a focus on how to present methods and results in a technical report. In their writing, the students should implement what they have learned. To support the students, development that has been already implemented in the lectures, is to showing good examples of how to present results in good way.

Stage 3: Discussion of the students' peer response related to the criteria. In the course today, peer response is already used, where the students should critically review a report from another group. However, the students have no instructions or criteria in their review work. An improvement would be to give the criteria to the students in the beginning of the course instead of in previous years, where the criteria are given after the students have handed in the final report.

Stage 4: Feedback

Students need to work with feedback to better take to account for the comments that have been given to them. There has been some development the recent years of how to give feedback, but it can still be improved. The best way would be that the students hand in their writing, get feedback from the teachers, and then the students work with the feedback to improve their writing. A large issue with this approach is that it is very time consuming and is not realistic for large student groups. So, some possible solutions could be: to use PhD-students for corrections of the technical reports, to use students for peer response, a log book: students write down in a log book their response of the feedback they have got, and the students hand in a rewritten assignment or to work with minor tasks, improving writing for parts of a technical report. For instance, give feedback to an introduction, method or/and results before the final hand in.

In the development for this course, we plan to use student peer response. The students will get clear criteria when reviewing another groups' reports, and the criteria will also be discussed in the lectures. Furthermore, the students will also work with the feedback they have got; and in this way they can improve their writing before handing in the final version to the teachers.

4.2.3. *Assessment Activities*

As the writing within the main framework is seen as an incremental process which ends with the delivery of a master thesis, in this course there will be two AAs connected to it. First, the introduction will be assessed independently as a piece of work in which they have experience due to the work performed in *"structural systems"*. Second, the assessment of the whole report emphasising the parts related to method and results which are the main core of the writing piece in this course. The last assessment activity will connect to the review and evaluation of the work of fellow students.

4.3. Concrete structures

"Concrete structures" course takes place at the end of master program, and more importantly it is followed by the master thesis. That makes this course to some extent different form the others. In the first place, students have been together for almost a year and a half, which means that they know each other rather well and they have gone through many group projects. Secondly, the writing they do here is the last piece of writing before the master thesis. In other words, they have written a significant amount of texts which means that they have already acquired some expertise. The demands related to the writing part, then, will be higher. However, the writing will focus more on the discussion and conclusions part.

4.3.1. *Intended Learning Outcomes*

As such, the main objective of the intended assignment is that students become familiar with the formal aspects of technical communication texts, particularly in what and how the results should be presented and discussed. Then it is possible to write the main ILO related to the writing:

1. **To recognize and apply in the production of own texts the formal aspects shared by texts used for technical communication (articles, technical reports, theses, presentations). The focus is placed on the discussion and conclusions.**

Along these lines, the general learning outcomes of the course to which the writing will help to reach after completing the proposed assignment are the following:

2. To perform design work in project teams concerning continuous beams, predict the response using non-linear FE-analysis, and present the approach and results in written technical documentation.
3. To perform investigations in project teams concerning structural response using non-linear FE-analysis, interpret the results and present and discuss conclusions orally at a seminar.

4.3.2. *Aligning TLAs with the course/assignment ILOs*

The writing parts of the FEM project will be scaffolded by following same structure as before. That means that before starting with the main writing activity 2 hours of lecturing time related to discussing results and draw conclusions will be given. In it some basic and relevant information will be provided in order to set up the basis for the main task. Same approach has followed for structuring the main writing task which is divided in 5 stages to provide a better understanding and smooth transition through the written report and the final presentation.

***Stage 1**: Discussion of a technical report; discuss results and extract conclusions.*

First, all students should read few report examples, putting the focus on the discussion. Many students show problems in differentiating between results and discussion sections, so they should reflect on that information and try to answer what are the critical differences. Subsequently, the students should write a brief list describing 3 to 5 crucial aspects related the discussion and stating why they are critical. Here, the writing should be quick and at a personal learning function level.

Then, the group has to put in common the different aspects sort them in order of relevance and discuss why they think the final choses are relevant.

***Stage 2:** Feedback.* Students need to work with feedback in order to take into account the comments given to them in task 1, see Figure 2. They have to hand in a response to this feedback.

***Stage 3**: Hand in task 2.* The students will hand in a presentation with extended notes related to the task 2 in the project. They have to structure the presentation to present a discussion of their results motivating the different choices and the conclusions extracted.
***Stage 4**: Critically review another groups' task 2*. Discussion of the students' peer response related to the criteria given in the beginning of the course, instead of in previous years in the end. Assessment Activities

4.3.3. *Assessment Activities*

In this course there will be four AAs connected to writing. First it will be assessed the introduction independently as a piece of work in which they have experience due to the work performed in *"Structural systems"*. Second, the assessment of the parts related to method and results which are the main core of the writing piece in this course, which connects to *"Concrete structures"*. Next a general assessment of the report will be done focusing on the discussion and conclusion, which are covered by the ILO of this part of the project. Finally, the critical review of others project will be individually assessed as well within the oral presentation of the project.

4.4. **Master Thesis**

At Chalmers, the thesis is a course comprising between 30 or 60 higher education credits and it shall be produced by one student or two students jointly. The thesis shall be produced at the end of the education and lead to a deepening and synthesis of previously developed knowledge. The thesis shall emphasise the technical, scientific and artistic content of the Master of Science in Engineering, Architecture or Master of Science programs. The overall aim of the thesis is for the student to demonstrate the knowledge and ability required for autonomous work.

4.4.1. *Intended Learning Outcomes*

The master thesis involves a large number of intended learning outcomes but four of them are the most relevant connecting to writing:

1. Choose and justify the choice of method in the project, within the main area/specialisation of the program
2. Contribute to research and development work, and be able to relate his or her work to the relevant scientific and technical/industrially/architectonic contexts
3. With a holistic approach, to identify, formulate and deal with complex issues critically, autonomously and creatively
4. Present clearly and discuss his or her solutions in English, as well as the knowledge and the arguments on which these are based

As the master thesis is developed around a written report, no additional ILOs are defined, as the ones defined already embrace writing. However, additional activities to support the achievement of such ILOs are planned and defined in the following.

4.4.2. *Aligning TLAs with the course/assignment ILOs*

The main activities presented here are meant to cover the previous ILOs. In addition, to provide to the students with consistent structure three main activities are designed which are organized according to the presented content for the other courses. The workshop form is used, and all the students within the master program must take part. The master thesis has an approximate duration of 6 months, and the workshops are distributed along this period. The proposed workshops, see

Figure 5, are also connected to additional activities which are meant to support for the workshop advance and the thesis structure.

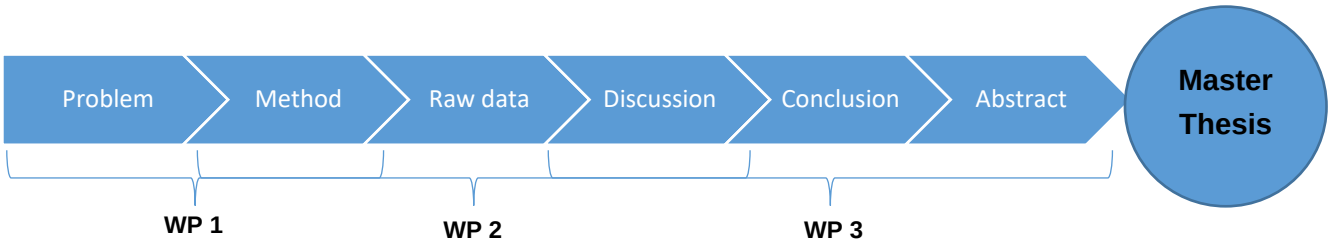

Figure 5. Activity implementation description.

Workshop 1 – Planning of the project: the first workshop takes place at the very beginning of the project. In this workshop, ILOs 1 and 3 are addressed in greater detail. The main purpose of this workshop is to help the students to define the problem space and scientific space of the team's project. In addition, the workshop gives the students a broader perspective on their project by gaining a better understanding of the isolated parts of their processes. The broader perspective guides the project members in project steering issues, while understanding of isolated parts highlight risks in the process.

After the workshop, all the teams should have: identified areas of application, identified scientific theories/methodologies, identified adequate sub-studies, got an introduction to Mendeley and handling of references. In addition, the teams should be able to: map a scientific approach, write a well-defined problem, and identify the scientific field of their specific project.

As a preparatory task for this workshop, students are required to draft an introduction to the project. The students must read few examples of last year introductions and subsequently they need to generate their own introduction. This activity is meant to connect to the work done during the *"structural systems"* course.

Workshop 2 – Scientific approach and area: the second workshop takes place approximately one month after the first one. In this workshop, ILO 2 is addressed in more detail. The aim of this workshop is to give the project groups a broader understanding of their contribution to a wider perspective. Finally, the scientific approach of the thesis project is revised.

After the workshop all the teams should have: identified the research domain that the research contributes to, made a critical reflection on their approach to the objectives, and drafted the theory/literature review section of the thesis.

For this workshop the preparatory task is heavier, which at the same time is divided into four different parts which intends to address different aspects of the written document:

- *Task 1 – References*: identify your three most important scientific references for your thesis.
- *Task 2 – Reviewers*: identify three scientists that are most appropriate to review your work. Look at their profile, list of publications, see their homepage.
- *Task 3 – Scientific approach*: this task encompasses few parts.
    - Try to categorise elements of your introduction into the basic categorisation scheme: who, why, what and how
    - Critically evaluate the data that have been collected about the project objectives.
- *Task 4 – Theory/Literature review*: Draft of your theory/literature review chapter

Workshop 3 – Planning of the project: the last workshop is conducted late in the project period. In this workshop all the presented ILOs are addressed. The main purpose of this workshop is to help the project team with a process that analyses the project's results and conclude them in an

appropriate way. In addition, the students should become aware of the importance of aligning the conclusions with the project objectives. This workshop connects thoroughly with *"Structural Concrete"* and *"Concrete Structures"* activities.

After the workshop all the teams should have: identified their specialised knowledge, identified key-information in the results and their relation to specific objectives, identified the connection between objectives, results, discussion and conclusion, understood the components of a report´s discussion and conclusion chapters, and understood the components of an abstract. In addition, the teams should be able to: write a clear and concise discussion and conclusion chapter, make sure that the conclusions are well supported and correct, claim the scientific field of their specific project, write an abstract.

Again, for this workshop the preparatory tasks are quite demanding, and they require some work prior the workshop.

- *Task 1 – Abstract*: in this task the students have to do to different activities, the first one consists in the assessment of 3 other abstracts which are given in advanced. They need to go through them and finally grade them from 1-3, indicating how well they summarize the content. The second activity is to draft their own draft for the mater master thesis, trying to follow the guidelines and the given examples.
- *Task 2 – Abstract seminar program*: they practice and learn on how to write abstracts and it can be used for the presentation's seminar program in which the master thesis will be defended.

4.4.3. *Assessment Activities*

In this part of the project, no specific assessment tasks are proposed as the master thesis is the main result which is assessed by the examiner/supervisor. However, the supervisors are expected to provide continuous assessment of the required tasks, which should ensure feedback in adequate time for the different parts of the document. In general, what is intended to be assessed after the writing of the document are the communication skills of the students.

5. Discussion and expectations

The presented project tries to provide a necessary framework for improving students' writing. One of the most relevant things to have into consideration when implementing such framework is how the framework is going to be perceived by the students. It is very important that students feel a connection between the different presented activities; hence, they get the whole picture and clearly understand the purpose and goal of the project.

The different affected courses in the program are quite spaced from each other. So, there is a risk that the students do not perceive a conducting threat. In addition, there are many other writing activities within the master which are not affected but this project that may induce confusion for the students. Consequently, it is pertinent to emphasise during the development of the different activities what and why they are going to work, and what is even more relevant how this will help them for a better development of their master thesis, which is presented as the major challenge in the program.

From past experience from the already implemented activity 4, the workshops within the master thesis, it has been seen few positive things that need further evaluation:

- Early involvement in the writing process.
- Discussion at supervision meeting are deeper and connected to the study progress in general and thesis project in specific.

- The students are more prepared to plan, manage and execute RAD projects in industry.

If the project is successful in providing such connections between the presented activities, we believe that the students will be able to develop better quality theses, but more significant, the writing process should be seen as a part of the process in a wider and transversal perspective, a tool which allows them to communicate their findings and research.

6. References

[1] MPSEB program – https://goo.gl/FjD2ui

[2] https://www.chalmers.se/

[3] J. Hattie and H. Timperley, The power of feedback. Review of Educational Research 77, 81 (2007).

[4] Structural Systems – https://goo.gl/GAtsLU

[5] Structural Concrete – https://goo.gl/CvFvQY

[6] Abaqus CAE – https://www.3ds.com/products-services/simulia/products/abaqus/abaquscae/

[7] Concrete Structures – https://goo.gl/pzkGg6

[8] TNO DIANA – https://dianafea.com/

[9] Mayer, R. and Moreno, R. (2003) Nine ways to reduce cognitive load in multimedia learning, Educational Psychologist, 38 (1), pp. 43-52.

[10] Byggs, J., Tang, C., Teaching, fo Quality Learning at University, Third edition.

[11] Swales, J., Feak, C., Academic writing for graduate students: Essential tasks and skills, 2012