USING WRITING AS A COGNITIVE TOOL IN A CAR DESIGN PROJECT

Carl Johan Carlsson
Chalmers University of Technology
Centre for Language and Communication
Olof Wranne
Chalmers University of Technology
Department of Product and Production Development

Abstract
The purpose of this paper is to give a short overview of a successful attempt at integrating communicative skills and disciplinary skills into a design project at the *Product Design Engineering Program* at Chalmers University of Technology, Sweden. The course setting provided the students with an open-ended task where the body of a car was to be designed based on specific car categories. This individual project was supported throughout by lectures, seminars, workshops, peer response sessions as well as individual tutorials, all regarding both content and communication. The overall purpose of integrating language and content was to provide the students with a good learning tool and a cognitive approach to choices made and actions taken in their own design process. In this sense, *awareness* about all aspects of the design process was a focal point. This was done by establishing the relationship between different modes of communication (writing, speaking, sketching and modeling). This also included the introduction of communication as part of the actual design process, rather than just a means of communicating a finished product. The outcome of the design projects and the experiences during the course will be used for further analysis and input for further development.

Key words: language and content integration, communicative skills, design process

Introduction
This paper describes the first steps in developing an integrated learning environment where core disciplinary contents and communicative skills were used in order to improve students' performance when working with a design task. The course context was a design project where second year students at the Product Design Engineering program at Chalmers University of Technology experienced different methods for conceiving and designing the exterior body of a car. The students were given an open problem to solve where a car design for a specific segment of consumers was to be explored. The course project resulted in a report with analyses, sketches, CAD drawings and arguments for the chosen concept. The purpose of this paper is to investigate the reasons for integrating design subjects and communication training as well as potential problems with such an approach.

The ability of communicating clearly has been an important part of the CDIO initiative from the start, and various ways of integrating communication into the core disciplines have been tested. The importance of communicative skills is now widely recognized, and the successful combination of discipline knowledge and the means of communicating it is something many engineering programs are looking for today. Here, *employability* is often an aspect that is brought up when communication is dealt with in engineering education.

There are many examples of good experiences of integrating communication and engineering subjects to form experiential learning situations [1], both in projects, teamwork, and in more traditional core disciplinary courses. At Chalmers University of Technology, the Centre for Language and Communication is involved in several communication intensive integrated courses. An example of this are the short but recurring (progressive) elements in courses during the first three years at the Mechanical Engineering program as partly described by Evertsson *et al.* [2]. Other examples of effectively integrating communication into engineering programs are the different communication themes developed in cooperation with e.g. the programs for Civil Engineering, Business Development and Entrepreneurship for Construction and Property, and Industrial Engineering and Management [3, 4, 5].

By using valuable experiences from various activities focusing on "writing across the curriculum" (WAC), "communicating across the curriculum" (CAC), and "writing in the disciplines" (WID) [e.g 6, 7, 8, 9], a transition from a tradition of separating subject knowledge and communication skills to an inclusive view on subject knowledge and communication skills has been made possible. For this apparent symbiosis of core contents and abilities to work efficiently in a course setting, a genuine investment in mutual understanding of the specific learning outcome must be made by the teachers involved. This also puts special attention on the design of the particular tasks as well as the overarching structure of the course itself.

Of course, there are always potential problems involved in an approach where different disciplines are integrated to form unity and conceptual harmony in a learning environment. Apart from the obvious risk of leaving integration to merely become a theoretical concept in the actual running of the course, there is also a clear risk of maintaining a view of communicative skills as only a means of communicating the end product rather than a means of *understanding* and *developing* the actual process. The concept of *writing to learn*[1] [e.g 10, 11] was therefore of great importance during the entire project.

This approach where writing is seen as a constituent of the actual learning process, rather than "just" a means of communicating information and experiences to others, means that the students can utilize writing at all stages in their design process. Instead of "leaving it to last", the students can incorporate writing as a means of *learning/understanding* at the the very start of the project and continue formulating ideas and concepts throughout the entire design process.

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[1] Here the interpretation of this approach also includes *communicating to learn.*

The design projects
In the course *Design and Communication*, the students were given an open-ended task to design the exterior body of a car. The course elements included, among other things, sketching techniques, analyses of design elements in cars, search strategies for source information, communication training and report writing. The language for the entire project was English and therefore elements of language training were also incorporated into the course.

The project was introduced during the first week of the course and the final report was handed in after seven weeks. The results from the project were also presented in a seminar where the students displayed their concept on a poster and with a scale model of their car.

During the running of the project, several attempts were made to encourage the students to *verbalize* the process and the choices made for the particular design. This was done both in short pieces of writing and in short presentations. The presentations were given and directed to the other students in order to initiate cooperation and exchange of ideas. *Peer response* was also an important part of the project, and students were asked to give written and oral feedback on the development of the project as well as on the final report.

There were four different categories for the car design and the students were asked to choose one of them. All in all, 30 students were then divided into four concept groups based on these design categories:

1. Family car
2. Urban car
3. Premium car
4. Ecology car

Even though the same category could be chosen by several students, all projects were carried out as individual projects.

These car categories were only very loosely described to the students at the start of the projects, as the definition and what that meant to the design was one of the first tasks for the students to analyze. The categories were based both on car types and on customer categories, why the definition of customers was essential to the choice of the design concept. The students were encouraged to investigate and register what cars look like, who uses them, how they are used and why they are used. This initial *conceptualization* of cars, their uses and their users was an important step in order to avoid presumptions and premature design ideas based on personal taste rather than on thorough analyses.

The work with the projects was carried out in the design studio where the students have their own workspace. Lectures and workshops were also given in the same environment and focus was put on different hands-on experiences where the students used either writing, speaking or sketching/modeling to perform different tasks. As the course also included general communication skills, various exercises, lectures and tasks including report writing input, stylistic issues and language (English) training, were also carried out in the design

studio. Tutoring, both regarding content and language/communication, was offered continuously throughout the project.

During the project, the students were asked to use several different means of establishing the choices of design manifestations. This was done in the form of process writing, discussions, sketching and modeling. Most of these activities were imposed by the teacher and therefore part of the course layout, but the students were also encouraged to use these strategies on their own.

At an early stage in the project work, the set communication tasks during the course included a seminar where the students presented their plans, ideas and possible problems they had encountered. This was done in small groups with 8-10 students in order to encourage active participation from all the participants. A similar setup was used for the final presentations that were also given in a seminar together with "advertising" posters for the chosen design concepts. Other written tasks during the project included a planning report, process writing (e.g. descriptions/explanations to sketches etc.) in order to conceive ideas, and a final report. Furthermore, various communication exercises such as descriptions of complex geometrical relationships, stylistic issues in writing as well as text structure, paragraphing etc., were also part of the course.

Apart from teacher input in the form of voluntary tutorials, students also read each other's texts and provided valuable input. By involving the students in this type of collaborative work, both the writer and the reader will gain valuable insight that will help develop their own work. This, since the reader will provide feedback to the writer, but also, since the reader will learn from actually reading and commenting someone else's work. This type of interaction with peers, or *collaboration* [12], has proved to be very useful in promoting student learning [13].

Finding and establishing a relationship between the various communicative processes was a very important aspect of the course. This meant that the students worked on combining text, sketches and models so that the expression was the same in all of these *modes*, and that the parts were clearly coherent. This was also something that was part of the assessment of the projects and the students' performance.

Outcome
By establishing a reciprocal relationship between the design process and the writing process, the purpose was to allow the students to experience communication skills and attitudes as a helpful tool in approaching and working with a design project. The introduction of iterative and process oriented writing as a means of *learning/understanding* together with the equally iterative sketching process, gave the students effective learning tools for conceiving a design concept. The shift from only seeing writing as a final product in the form of a report to seeing it as a *process tool*, meant that the writing process in this course was emphasized as being an integral part of the actual design process. In creating a close link between analyzing, sketching, modeling and writing and communicating, critical thinking and awareness became important constituents of the entire design process.

The dual function of communicating was a key factor in the course. This meant that the students were encouraged to use writing both as a means of "outward" communication but also as a cognitive tool during the actual design process in order to conceptualize their ideas. The ideas were also tested in a seminar where the students presented their work in progress, allowing valuable input from peers.

As the course also included generic communication skills as well as general sketching techniques and design concepts, the project work was complemented with lectures, workshops and exercises training these abilities. However, the main focus during the course was the car design project and all extra learning activities during the course aimed at strengthening the students' performance during the project.

A comparison with previous outcomes from a similar design project from an earlier year showed that the result of the current project was qualitatively improved in several aspects including the final report and presentation. The students managed to express and give evidence of critical thinking and careful analysis of a design project. Together with this, sketches, drawings and models were overall also improved.

The next step
Further analysis of the outcome of the design project and ways of further implementing effective learning strategies still needs to be done. Problems regarding the experienced *vagueness* of an open-ended design task must also be discussed. However, leaving the task rather open to interpretation was a deliberate choice in the planning of the course as a way of inviting the students to critically analyze the task and what information they needed to search for.

Assessment is another area that must be investigated as the integrated course setting may demand other requirements on feedback and grading than a traditional course. Finding a balance both between the different roles of the teachers, and the roles of the different course contents is important. Still, there is a potential risk of wanting to separate different skills and content knowledge, and by that enforcing a view of communication skills and content knowledge as distinctly different and separate to one another. Therefore, it is vital to the outcome and the feedback to the students that the teachers work together in assessing the projects and the learning outcome. In doing that, the apparent duality of content and communication is not seen as a dichotomy or merely as "connected", but rather as intrinsic parts of the same issue.

Ideas and other experiences of alternative approaches will be an important part of the continuing evaluation of the project. By presenting the work so far, it is also our hope that experiences from the conference participants will contribute to the continuous development of this project and similar projects in other courses and engineering programs internationally.

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