STUDENTS' EXPECTATIONS AND EXPERIENCES RELATED TO THEIR CONCEPTUALIZATIONS OF PREVAILING CURRICULUM - ALIGNMENT OR DISSONANCE

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Abstract

In a longitudinal study four students, in four cohorts of engineering students, have been interviewed on a regular basis, from enrolment until graduation and their entrance into work-life. Their expectations, motives for studying, study motivation, experiences of teaching and learning and knowledge and experiences of the implementation of a CDIO curriculum are discussed and related to the implementation process. The results are presented as four cases. From the students self-reported experiences one conclusion is that these students did not know very much about the epistemological or pedagogical considerations behind the implementation. They associated the CDIO-project with project-work scheduled as modules in their curriculums. The students´ *motive*s for enrolling in the Y-program were related to its´ wide base, meaning they could delay their choice of profile until later, and its´ reputation as "the toughest" and "the best" program. Their *motivation* for carrying this out differed, from being future oriented with hope for good and interesting jobs, to here-and-now oriented with a focus on the joy of studying and being a student. Their motives and motivations influenced their *approaches to studying* in relation to their conceptions of the prevailing curriculum, which was very much the same in all cohorts.. For some of the students this was dissonant or incompatible with their personal conceptions of learning and contributed to their loss of study motivation at times.

Keywords: Curriculum change, student experiences, teaching and learning, motivation

Introduction

In previous CDIO conferences I have presented papers based on emerging results from a longitudinal study where the students enrolled in the study program of Applied Physics and Electrical Engineerig (the Y-program) in Linkoping 1998, 1999, 2000 and 2002 are surveyed annually throughout their study time with a follow up one year after graduation [1]. In line with several other European studies our data indicate that during the last years, there has been a change in students´ attitudes to studying and working. In this paper I will present interview data where the students´ study motivation, experience of teaching and learning and knowledge of the implementation of the CDIO-project are discussed and related to the implementation of the CDIO curriculum.

Clarification of concepts

The implementation *process* is defined as a *learning and development process* [2] (L&D) with the aim of making graduate engineering education more applicable and to give more attention to the students´ employability. L&D involves three dimensions of learning and teaching, knowledge, skills and competencies and acting. The concept of knowledge involves cognitive capacities and use of analytical thinking; skills and competences involves capabilities to use relevant knowledge in relevant situations and contexts; acting is what people actually do in practice. The way people act is influenced by emotions, values, attitudes that individuals experience in a context or situation.

The four cohorts of students are categorised as
- 1998 - the base line who enrolled and graduated within a traditional curriculum and witnessing the implementation process
- 1999 - enrolled in a traditional curriculum where the management and the staff were planning the CDIO-project. CDIO-project in their third year.
- 2000 - surveyed and involved in the planning process. CDIO-projects in their third and fourth year.
- 2002 - the first CDIO cohort. CDIO-projects in their first semester, third and fourth year.

In this paper the results from student interviews will be presented as *four cases*. A case includes four students within a cohort who have been interviewed 4-7 times, from their first semester to graduation, with a follow up after leaving the University.

A CDIO program is based on standards guiding the planning, implementation and evaluation of courses and programs in Engineering education [3]. The CDIO initiative was introduced at Linkoping University in 1999, and has since then been implemented in many courses and Engineering graduate programs. A CDIO program is characterized by an *approach to teaching* where learning outcomes are addressing disciplinary content as well as personal and interpersonal skills and where process, product and system building skills are focused. The teaching should be organized and carried out in an integrated curriculum with a sequence of design-implement experiences in workspaces specifically designed to support them. CDIO programs are evaluated through the use of a standard-based model. The purpose is to evaluate if CDIO programs are effective and concerns the cumulative results of the educational experiences offered to students. To summarize the CDIO is based on standards guiding the planning, implementation and evaluation of courses and programs in Engineering education.

Aim of the paper and questions to be discussed
The aim of this paper is to high light the students´ perspectives on their L&D process during a period where a CDIO curriculum is planned and implemented in their study program. How are the students' expectations and experiences related to *their* conceptualizations of the prevailing curriculum and how do they conceptualise and act on *anticipated changes*? How are feelings of satisfaction and dissatisfaction conceptualised and acted out?

What are the students´ expectations of their study program and what are their motives and motivation for studying and their experiences of teaching and learning? How is this conceptualized and acted out?
How do the students´ conceptualise the enactment of the prevailing curriculum and anticipated/realized changes?
Are the students´ expectations and conceptualizations aligned or dissonant with the prevailing curriculum?

Disposition of the paper
1. Background- the Y-program
2. CDIO standards and the implementation of the CDIO curriculum in Linkoping
3. Results from interviews with four students in four different cohorts of engineering students
       a)Motives and motivations for studies.
       b)Experiences of teaching and learning, teaching staff and study environment.
       c)Knowledge and experiences of the CDIO-project
4. Conclusions Alignment or dissonance between curricular standards and students´ expectations and experiences of teaching and learning in a specific learning context.

Background

When the study was carried out the Y-program was a 4½ year graduate study program. It was marketed as one of the toughest and most demanding graduate programs in Engineering. The students had a reputation of being ambitious and clever, but also a bit square and dull [1]. The program was managed by a study board within the Deans office. The board had an elected chair and the members were

- Teachers from the departments running the specific classes
- Students from different cohorts
- Administrators from the Deans office.

A study program does not belong to a department but "buys" courses from different departments. Every August between 180- 150 students were admitted. They were enrolled to 5-7 classes with about 30 students. Female students were in minority, between 13-20%, and they were allocated to some of the classes, which means that there always were some all-male classes. Senior students were appointed as form masters/mistresses, teacher assistants, mentors etc. for first year students.

The curriculum the first year consisted of a foundation course in mathematics, linear algebra and perspectives on mathematics and physics. From 2002 there was an engineering project (a CDIO-project) the first semester. The work was organised in lectures (the whole cohort); classes (lessons with one class); laboratory lessons (the students work in pairs or small groups) and projects (small groups). Lectures were given by professors, who also tutored and supervised projects. Teaching assistants were supervising in classes and laboratory lessons. Course evaluations were made on the internet and the results communicated to the chair of the study board, where they were followed up and attended to. Each course was evaluated according to a scoring system. An examiner could get an honourable mention or a request to make some improvements. Class representatives met with the examiner on a regular basis to give feed-back from the class.

In 1999 the CDIO-project was initiated. This was rendered possible with a financial support by the Knut and Alice Wallenberg foundation. The main purpose of the project was to make graduate engineering education more applicable and to give more attention to the students´ employability. In order to meet the critique from the 1998 cohort of a tough start in mathematics, a foundation course in mathematics was launched this study year.

In 2000 a new class was launched, Yi (Y international). The students were offered classes in a foreign language and to spend one semester in a foreign country. These students were not supposed to participate in the CDIO project course during the first semester. The implementation of the CDIO curriculum started in 2000, with structured interviews with all teachers involved in the Y-program in 2000/2001. The purpose of the interviews were to make the teachers familiar with the core concepts in the project, Conceive, Design, Implement and Operate. Another intervention in line with the CDIO-curriculum was that all new students filled in a "Beginners survey". The results were followed-up by the study counsellors. They identified what the main obstacles and problems were, and offered individual counselling to the students.

During the study year of 2001/2002 the implementation of the CDIO curriculum continued. The student reception was improved and the first CDIO project course was planned. Potential project managers were taught a project model, LIPS, and there was a request to different departments for interesting projects. The "Beginners survey" was launched to all students in

the Faculty of Technology, in order to make it possible to compare the different study programmes.

In the study year of 2002/2003 the first CDIO-project course was implemented during the first semester. Besides the follow up of the "Beginners survey" the study counsellors launched the idea of "Student mentors". The aim was to facilitate the students´ adjustment to university studies with the help of a counselling method "Supplemental instructions".

The implementation of the CDIO curriculum has continued from 2003, but this is beyond the scope of this paper. From the description above it is concluded that due to planned changes, the study contexts of the students were changing and this will be considered in the interpretation of our data.

The longitudinal study and interview data

This longitudinal study is based on data from four cohorts of engineering students enrolled in the program of Applied Physics and Electrical Engineering (the Y-program) at Linköping University in 1998, 1999, 2000 and 2002. Questionnaires have been distributed to all registered students and ten students in each cohort have been interviewed, on a regular basis throughout their whole study time with a follow-up one year after graduation [1]. The longitudinal study is based on a *student centred, learning* perspective. Survey- and interview data are based on self reported information on the students expectations, perceptions and conceptions of what teaching, learning and studying in the Y-program means. Program goals and intentions are interpreted and re-acted on by the students. In this paper the time dimension is high lighted as one important aspect of a L&D process. Within a 10 year span, from 1998 to 2008, the CDIO curriculum has been planned, implemented and evaluated and the interviewed students have fulfilled their studies, graduated and lived through and ended an important event in their life.

Interview data are not "facts", they are produced in a specific context and interpreted within some kind of theoretical frame work [4]. The interviewed students are all unique persons who through out the years have told their personal stories. In this paper these stories are grouped into cases, which is an academic construction in order to look for similarities and differences within and between these.

Interpretative and theoretical framework

A general change process can be defined by different phases, planning, implementation and evaluation. In a top-down change process management and consultants are the main actors in the planning process and when a decision is made of a model or a plan to be implemented the rest of an organisation is involved. In most organisations people at lower levels are informed about the planning through representatives of the staff or customers so that decisions made will have the support needed, in order to facilitate the implementation process [5]. In an educational context, in a study program, where students and teaching staff can be regarded as temporary members of a specific organisation, the study program, one problem is that information and knowledge fades away as student representatives graduate and the new students have no history, no knowledge of the background or reason for the changes to be implemented. For the new students there are no "previous situations" to evaluate their experiences against, there is mainly a dissonance or alignment with their expectations, based on previous study experiences and second hand information about the study program and study environment. The same dilemma occurs with teaching staff, because they teach in different classes and have other obligations as well.

These circumstances influences the evaluation process as the context is in a constant flux, with students, staff and policies changing while standards and guidelines are fixed. As the

focus in this paper is change processes in an educational context where the students and their learning are the reason for all the activities, a more appropriate way of defining the change process is as an L&D process [2] involving the phases of observation, planning, action and review. In the observation phase strengths and weaknesses are identified and in the planning phase objectives are set for L&D interventions to achieve specific outcomes and results. This involves action through professional methods and approaches and formative and summative evaluations and adjustments. An L&D process is similar to the CDIO process. The CDIO-curriculum can be described as a standard based, goal directed curriculum, developed in an international engineering context (www.cdio.org). A CDIO program is based on the principle that product and system lifecycle development and deployment are the appropriate context for engineering education. *Conceiving--Designing--Implementing--Operating* is a model of the entire product lifecycle. The *Conceive* stage includes defining customer needs; considering technology, enterprise strategy, and regulations; and, developing conceptual, technical, and business plans (Observation in L&D). The second stage, *Design*, focuses on creating the design, *i.e.*, the plans, drawings, and algorithms that describe what will be implemented (Planning in L&D). The *Implement* stage refers to the transformation of the design into the product, including manufacturing, coding, testing and validation (Action in L&D). The final stage, *Operate*, uses the implemented product to deliver the intended value, including maintaining, evolving and retiring the system (Review in L&D). In a CDIO program, the criteria of success is the fulfilment of the 12 CDIO Standards. A program is considered effective if it can show evidence that the program components described in the Standards are in place. Different stakeholder groups will emphasize subsets of the 12 Standards, but all Standards are important measures for at least one stakeholder group. The CDIO concept is *teacher centred* from the point of view that it guides faculty how to *teach* in order to reach the goals. The longitudinal study is *student centred*, focussing the students perceptions and experiences of teaching and learning.

The CDIO curriculum has been planned, implemented and evaluated at different activity levels. In courses and programs the development has progressed in parallel with the development of the CDIO standards and the dissemination of the CDIO concept to Universities all around the world. The L&D process is decontextualised which has been criticised by Cote & Levine [6] who argue that learning is an individual process that takes place I a social context. They further argue that the outcome of a learning process is difficult to evaluate as an input-output process that neglects what happens in "the black box" the individual student in a specific context. In order to capture what goes on in "the black box" they have outlined an integrated model of *developmental contextualism* for dealing with person-context interactions. A basic assumption is that different persons experience different "fits" with a specific context. With widened participation and mass education this issue is becoming more important than before, as there is a tendency that study programmes and classes mainly are designed from an intra-academic perspective, by academics for academics-to-be, in spite of the fact that most students will have to be employable *outside* the academic world. Some studies indicate that unintended consequences of a situation where the design of study programmes are *not* aligned to the goals and motives of the students can be credentialism (i.e., education inflation in the process of job placement) and increasing rates of graduate underemployment [7]. Studies have been done on which factors that might be important in predicting who benefits most from Higher education setting and for what reasons [6]; [8]. From the results of a longitudinal study Cote & Levine [6] concluded that *input motivation for personal and intellectual development* best predicted output skills acquisition and academic achievement, independent of input intelligence quotient and adjustments in university settings. Their conclusion is that students input motivation for personal and

intellectual development is more important as predictors for student satisfaction and student retention than high points required for admission and/or curricular adjustment[6]. These results challenge other results indicating that situated conception of learning, like prior experiences of learning, may be indicators of approaches to studying and outcomes of learning [9] [10] A situated conception is one that is evoked and adopted by students in response to their learning tasks in a particular context and may reflect the aims they have for their studies *once they have started that study* and experienced that particular study environment [9]. The difference between these two perspectives is that the first one assumes that curricular and/or other changes are subordinated the motive and motivation of the individual, while the second one assumes that curricular and/or other changes influence the motivation of the individual.

Methodology
The results in this paper are based on interviews with four students in each cohort, that have been enrolled in the program for at least three years and have been interviewed on a regular basis 4-7 times. Most of them have graduated, but not all.

Case 1. Cohort 1998: Four students, three men and one woman. All graduated 2007. 18 interviews.
Case 2. Cohort 1999: Four students, two men and two women. Three graduated 2007. 24 interviews.
Case 3. Cohort 2000: Four students, two men and two women. Three graduated 2007. 25 interviews.
Case 4. Cohort 2002: Four students, three men and one woman. Three graduated 2007. 21 interview.

All interviews have been read through and in a first analytical step three themes were identified
- Background, expectations and motives and motivation for studying and enrolling in the Y-program
- Experiences of teaching & learning and teaching staff
- Knowledge of and experiences of the CDIO-project

In the second analytical step these themes were clustered within each cohort and arranged within relevant semesters. The students were interviewed twice the first year (S 1-2) and after that annually every spring (S4; 6; 8; 10; 12; 14). The last interviews were made the spring 2007. The students´ individual voices were reduced and citations that reflected common understands within a cohort were identified.
In the third analytical step the results from the first two steps were compared within the different themes and commonalities and differences between the cohorts were identified and the four cases were constructed.
Finally these results are discussed in relation to the interpretative frame of reference and to the research questions. The results are presented as "cases" to be discussed in the interactive paper session.

Results: Four cases

The curricular changes made in the Y-program, between 1999-2002, were part of the implementation of CDIO standards, with the purpose of fostering an approach to teaching where learning outcomes would address disciplinary content as well as personal and

interpersonal skills and where process, product and system building skills should be focused. It is expected that teaching should be organised and carried out in an integrated curriculum with a sequence of design-implement experiences in specifically designed work-spaces supporting traditional teaching. In our longitudinal study the focus is on the students´ approaches to studying and learning within this context. The curricular changes are planned and carried out by a study board and teaching staff so the main question is how these intended approaches to teaching are interpreted and understood by the students, in relation to their motives, motivations and expected learning outcomes, and how are they acted out?

The results are presented as four cases, showing how the students in each cohort socialise into a specific context, and how their process of adjusting is intertwined with their personal motives, motivations and life events. An educational change process [2] [5] have different meaning for management and students. Students are temporary members of an organisation they depend on but may not be committed to, while management and staff are dependent on the competitiveness of the organisation for their survival. Management tend to plan and implement changes from an academic, teaching perspective, while students take a learning and development perspective [2], the context is the same but is perceived, interpreted and given meaning from different perspectives. A theoretical frame of reference used in the interpretation of the results is based on studies showing that students motives and input motivation for personal and intellectual development can predict outcome skills acquisition and academic achievement [5] but so can also situated conceptions of learning [9] [10]. A situated conception of learning is evoked and adopted by students in response to their learning tasks in a particular context, and reflect how they have experienced that context, once they have started their studies.

The cases are presented thematically, according to how the themes have evolved within each cohort, over time and if the students conceptualisations of the prevailing curriculum is aligned or dissonant with their expectations and experiences of learning and teaching.

Motives and motivations for studying
Case 1. Three students came directly from secondary school and one had substantial work experience at a shop-floor level. Motives for studying were related to anticipated job-opportunities in the future. The motivation for enrolling in the Y-program was an anticipated increase in their self-confidence if they could manage and graduate from a difficult and tough study program. Their explanations for managing and eventually graduating was that they had a talent for studying, they were ambitious and prepared to put in a lot of time and effort, even at great personal and social costs. They also managed their first examinations and did not lag behind too much. All four had graduated in 2007
Case 2. Two students came directly from secondary school and two students had some previous experience of work and studies. Their motives for studying were related to anticipated job-opportunities in the future and the motivation was the challenge of testing if they could manage to graduate from a tough and difficult study program. All students experienced more or less severe back-lashes and life crises through out the years in the study program and had different strategies to tackle these. One woman dropped out and took on a non-academic career, with a feeling of having failed. In 2007 the other three had graduated.
Case 3. Three students came directly from secondary school and one had some previous experience of university studies. Their motives for studying were related to the expectations from the world around them that "everyone expect you to study" and that an academic degree was a prerequisite for any job beyond the shop-floor and the supermarket. Their motivation was that they loved to study and learn. All students suffered from loosing their study

motivation at times and had different strategies to tackle this. In 2007 three graduated and one tried to pursue the studies and graduate, while working.

Case 4. Two students came directly from secondary school, two had some previous work experience. Two students came from private schools. Their motives for studying were that they had an interest in the subjects, they wanted to study and the Y-program had a wide entrance, meaning they could keep all doors open the first three years. They also wanted the challenge of a tough and difficult program. Their motivation was the joy of studying and learning. Working was no option. They did not know what to work with in the future and had no hurry graduating. Their study motivation had its´ ups and downs during their study time, one man was sick-listed for one year and had not graduated in 2007. The other students handled their lack of study motivation through engaging in extra-curricular activities and social activities outside of school and eventually graduated.

Summary and question
The students in all cohorts were very motivated at the beginning, and they were tempted by the challenge of the reputation of the program as tough and difficult. They had a motivation for personal and intellectual development [6] but despite that their study motivation had its´ ups and downs and a couple of the students did not graduate while some took study leaves that prolonged their study time. One difference between the cohorts was their strategies to cope with their loss of study motivation at times. The first cohorts were oriented to a goal in the future, a good job, and this orientation made them prepared to make personal and social sacrifices to reach that goal. The latter cohorts were oriented to the study-situation, they expected "studying" to be joyful and a pleasure. They had no options and resisted to think about an insecure future "after school". During their study time they also had life experiences that influenced their study situation and many of the interviewed students had voluntary and non voluntary study leaves, for shorter or longer periods, where they tried to get on the track again. *One question to be asked is if student motivation is a matter for the individual student or if it is of matter for the study context.*

Experiences of learning & teaching, teaching staff and study environment
Case 1.
The first two years were very tough and the adjustment to the university was difficult, but having managed so far, they defended the tough start because "you know what it will be about". The toughness was much about time pressure, pace and tempo, related to learning. They adjusted to a way of studying and learning with a focus on passing their examinations and not lagging behind, but they complained about cramming and surface knowledge "it is the deeper knowledge you miss". Their fifth semester, "autumn in year three", was "the worst thing I ever have experienced" but also a turning point because after that, everything was surmountable and they began to see "the end of it". The study situation became very different, fewer lectures, more self-instructional and individual studies and optional courses that were more realistic and applied. Close to, and after, graduation they identified the benefits of the program as being that they had learned to learn, learned to take initiatives and work independently and the most useful contents were the engineering-technical knowledge and skills as a whole, but not so much "the courses". Their study strategies the first two years were to attend most scheduled lectures, lessons and laboratory work and besides that study alone. After the first two years they cooperated more with friends and worked in groups. Experiences of teaching staff was that they made a difference between lecturers, with whom they had no personal relations, and teaching assistants, who were more available and "tried to do their best". The lecturers were not all of them skilled or competent teachers, although they knew their subjects.

Case 2. The start was tough, four parallel courses and much scheduled time. They handled that by giving priority to working on their own and *not* attend all scheduled lectures and lessons because they "wanted time to think about what they were doing". Their feeling of stress was related to their perceptions of learning as elaborating and understanding, and their experiences of teaching as transmission of "stuff within strictly scheduled modules" and that examinations were of decisive importance for their grades. The fifth semester was "just madness, no other word for it", but having overcome that threshold they were more satisfied with their study situation and their fourth year was considered very relaxed. Their study strategies were to quickly adjust to the expectations "just cramming for the examinations and after that you do not remember anything". After the first years they argued that this adjustment to a way of fostering "course- and credit picking" had the consequence that later, when they had the freedom to organise their own studies, it was too convenient to continue on that learned road. Despite advices from management and study counsellors, that they should work more in groups, they preferred to work on their own. Their experiences of teaching staff was that they knew their subjects but that many of them could not teach without complicating things too much. Teaching assistants were better than lecturers to listen and explain. The students held a critical attitude to the "mentality" of the program, that students complied with heavy workload and stress and that criticising this attitude was not tolerated. This attitude contributed to their approaches to learning. Close to graduation, and after, they reflected on their education and the benefit of it was that they had learned to work quickly, under strong pressure and stress, to "take in" knowledge and get things done and to finish assignments on time. They associated this with personal skills they had achieved and not so much subject content.

Case 3. The students experienced a welcoming attitude from the start and the marketing of the program as "The best" made them feel that it was paid attention to and cherished. They experienced a heavy work-load but tried to cope with that through engaging in joyful activities like extra curricular activities, physical training, sports, computer games and TV. After the fifth semester they were left with a feeling that despite doing their very best it never sufficed. They anticipated that they were victims of lecturers´ strategies to make sure that the students produced enough in *their* course, and that these actions contributed to an uneven distribution of credits in relation to workload. After the third year their work-load was lowered, there were fewer parallel courses, more interesting classes, more applied knowledge, more fun and they had "learned" how to study. They adjusted to a way of studying with a focus on finding out what was important for the examination, but were not comfortable with that. Their study strategies were to study on their own "to think things through before joining in with study groups" and they were quite scornful of the advices from the "experts" telling them to work more in groups "these experts usually have not studied science or technology, they are behavioural scientists".

Close to, and after, graduation, they were proud to have managed the tough program and they felt very competent. They started to orient themselves outwards and they could relate what they had learned to real-life situations and integrate theory and reality. But they also realised that in relation to their future work life, their education was limited "I am qualified but have the wrong qualifications for my job". Teaching staff were considered qualified in their subjects but that their pedagogical skills were personally related.

Case 4. The start was a shock, but they got used to it quickly. Their responsibility for their own work, but also their possibilities to influence their study situation, surprised them. Four parallel courses and tight schedules were difficult to handle. They suspected that the study board had reduced teaching modules and credits but kept content and workload in order to cram in some new modules. The students used their influence to complain about that some courses were getting more scheduled time on behalf of others, of badly designed courses and

of the skewed relation between lectures and lessons. They also complained about lecturers "he will probably be replaced the nest semester". Their over all experience of teaching staff the first year was that they knew their subjects well but had difficulties in communicating that to the students. In the second year that lecturers had high demands, talked so the students understood and were good at explaining. After year three the students complained more about badly designed courses and they generally found that younger teaching staff were more helpful and understanding than older ones "it is as if they do not really have time for us". During the first years they were disappointed because they had lost their motivation for studying the subjects they originally were interested in "everybody loved physics…then we came here and had very boring lecturers and not you do not like physics anymore". After the third year their study motivation rose because there were more applicable courses, optional courses and real problems. Their study strategies were to study for their examinations and study on their own as a rule, but this also influenced their study motivation "as soon as I have to just study for the examination I really loose my motivation, but if I pass the examination I get motivated again because I have managed". After the third year their study strategies changed. They could organise their studies and had control on their learning "this suits me better, I learn so much more… I do not think I have become smarter but I had no time for thinking and reflection before". Close to, and after, graduation they realised that the more they had learned the more they would still have to learn. The benefit of the Y-program, in relation to work life, was that they could solve problems and apply their knowledge. Despite that they did not know where they were heading the first two years, it eventually became clearer and clearer.

Summary and question
The students´ conceptions of teaching and learning when they enrolled were related to their experiences of what was expected of them in the context of the Y-program. One of the reasons for the study board to engage in the CDIO project was that they wanted to change the program to "foster an approach to teaching where learning outcomes will address disciplinary content as well as personal and interpersonal skills and where process, product and system building skills should be focused. It is expected that teaching should be organised and carried out in an integrated curriculum with a sequence of design-implement experiences in specifically designed work-spaces supporting traditional teaching". The planning of this started in 1999 and was fully implemented for case 4, the cohort of 2002. The questions are if the students´ approaches to studying and learning changed over time, within and between the cohorts, during that time, and if those changes were related to their knowledge of and experiences of the CDIO project.

All students experienced the start as tough and the workload heavy, due to many parallel courses, much scheduled time and a high tempo. The first cohort found that tough but fair, as it was regarded a quality marker to ensure "the survival of the fittest", while the latter cohorts noticed, with some surprise, a welcoming atmosphere and support and invitations to influence the realisation of courses and program. The experiences of teaching were that the design of the courses and the teaching fostered cramming, credit-picking and studying for the examinations. The reason for that was that it was the results of the examinations that decided their futures, despite home assignments and group- and project work, which they enjoyed but also were time-consuming and took a lot of effort. Their situated conceptions of learning contributed to a behaviour where they quickly adjusted to a way of studying, which they believed would help them to manage this [9] [10]. Their study strategies were to attend scheduled lectures and lessons, to study on their own as a rule but to study with friends "when needed". These approaches to studying were aligned to their situated conceptions of learning

but not with their personal conceptions of what learning meant, which were more associated with time for thinking, reflecting, discussing and doing, i.e. calculations.

The students in the latter cohorts reacted scornfully to the advices they were given by their study counsellors, that they should not work so much on their own. The end of year two and the beginning of year three, were considered "madness" because of the very tough assignments and heavy work-load. But this was also a turning-point, because after that, year four was considered rather relaxed with optional courses, more motivated students and lecturers, smaller classes with more personal communication, more self-instructed and independent studies. Now, they realised that they had the opportunity to change their study strategies, to study more for learning, but they now found it difficult to change their study habits and they were not prepared to risk "a winning concept" when they began to "se the end of it". There were differences between the cases in this respect. The students in the first cases took the study situation as a fact "this is how it is and must be" and had strategies to adjust. The first cohort in accepting that managing this was at a high personal and social cost for the benefit of a better future and the second cohort through reacting on and blaming the "mentality" of the program and trying to escape that context, for shorter or longer periods, to get inputs from outside. The latter cohorts, especially case four, complained and tried to influence the design and implementation of courses and of the program as a whole. These differences between the cases can be interpreted and understood in different ways, depending on theoretical perspective. From one perspective, in line with Coté & Levine [5] the difference is explained by the students´ input motivation. The first cohorts had a focus on their future, and their strategies were aligned with that, to endure and survive here-and-now, in order to gain something later on, self-confidence, pride, status and a good job. The latter cohorts had a focus on here-and-now, as their motivation was that they "wanted to study and they loved to study and learn". Their motivation was more contextual and relational and vulnerable to their experiences of the approaches to teaching, which were not aligned to their expectations of what learning and studying should be, and therefore it was also a threat to their self-image. In order to pass their examinations they *had* to adjust to and start thinking about studying, not as joyful and relaxed, but as hard work, cramming and time-pressure. In order to manage this they searched for strategies where hard work could be combined with leisure and free time.

The students who had experienced project-work appreciated this very much, but these modules were considered as appetizers in a long, boring, traditional dinner. They were also considered as consuming much time and effort, and therefore as interfering with their "course-work". *Questions to be asked are what the change in motivation means for the design of a curriculum means with respect to teaching and learning and retention.*

Knowledge and experience of the CDIO-project
Case 1. There werenNo planned CDIO activities in their curriculum. They knew nothing about CDIO until 2002/2003 when they "had heard" that "they" were moving modules and were planning a project work the first semester. They also had heard that "they" were adjusting the program standards to new groups of more inferior students. They worried about the reputation of the program if the changes meant adjustment to make it easier to pass. From their personal experiences they had opinions about these anticipated changes, they believed project work in the first semester was too early and they worried about the quality of the program.
Case 2. An optional CDIO course was planned for their third year and it was not until year three that they commented on the CDIO-project. By then they knew that "they" were changing the program and planning a project in the first semester. From their personal

experiences they welcomed the idea but were worried that there would not be any time for project-work, that it would just be something added into an already crammed curriculum. They also were worried that it would not be taken seriously. After year three, when some of the students had taken the project course and some not, their opinions about it differed. The "experienced" had learned to apply a template and they had learned that project work could be fun but also that it consumed time and effort and that the experiences and results depended on the team-work and the task at hand ad how this was supervised. In the project-work they had the opportunity to apply prior knowledge and to work with real-world problems in all their complexity. The CDIO project was highlighted in their CV:s when they applied for jobs.

Case 3. After the first semester the students had not heard of the CDIO-project, but when they were informed about it, by the interviewer, they commented that "it sounded interesting". In year three, the students associated the CDIO-project with the "electronic-project" they had been involved in and which they had enjoyed very much. What they mentioned was the opportunity to construct something from the start until the test to see if it worked, but above all they commented that it took so much time and that the work-load was not in parity with the credits and this complaint recurred during their fourth year as well. From their personal experiences they questioned the meaning of having project-work during the first semester because "you do not know anything the first year". Their experiences of the projects in year three and four, related to their learning, was that they had learned a lot about project-work, but not so much theory. They had learned team-work and to structure and manage a task together. The experiences differed between the studens, due to the perceived relevance of their projects, their supervision and the quality of their team-work. Project-work was not considered to be "a course" because there were no lectures. In solving real problems they were, for the first time, allowed to use and apply what they previously hade learned. They did not learn anything new, or rather they thought they had learned new things but there was "no lecturer fobbing new stuff on you". They appreciated to have the project courses in their CV:s and the project-work in year four was mentioned as *the one module* they found very useful in their present job, because the competence of designing, planning and managing a project and the awareness of the importance of good and thorough documentation, came at hand in any engineering job.

Case 4. Working in a project the first semester was considered to be a very good experience, although it was a quite stressful and time-consuming activity. They considered that the work process and the team-work had been more important than the results, and therefore their experiences differed due to the relations between team-members and between the group and their supervisor. They were not sure of what the purpose of the project-module was, so they found it a bit unstructured and vague, more like a break from heavy maths-courses. After that project they described the following two years as "business as usual", with traditional lectures, lessons and examinations. In year two they still could not explain what CDIO represented, they could not tell the difference between a CDIO- and a traditional course. They associated CDIO to project-work. What they did remember from their first project was that it was a break from the traditional courses and that some people, but not all, had put in a lot of time and effort in the project. They also remembered the stages in the template, the LIPS model. They also had noticed that some traditional lectures had been replaced by "large group seminaries" but they anticipated that it had more to do with finance than with pedagogy. In year three all students were very enthusiastic about the electronic-project "it was great fun and a nice break from examinations and you had the opportunity to apply our knowledge". Compared to the first project, the first semester, they appreciated that this time they had to take a real responsibility for their project and that they were allowed to work very independently and that the supervisor was more of a consultant than a supervisor. The negative comments were about time, project-work was time-and effort consuming. In year

four there was a new motivating factor, as they had experienced that what they had constructed could be of use in real life. They also had learned from their mistakes in the electronic-project and they had learned that working in teams was something they had to learn "it does not just come to you". As the projects this year were more identified with specific institutions, where their optional courses were given, they also had learned that "the same" project-instructions could be managed and governed differently, due to the institutional culture and traditions. Their relation to their supervisor was more of a partner to discuss with than a traditional lecturer or supervisor. "we are expected to realise the plan on time and they check that". The skills and knowledge they found most useful in their present jobs were the project courses because they were expected to work in projects most of their time and "you have to be acquainted with toll gates and mile stones and stuff like that and to manage team-work.

Summary and question
The first three cohorts´ knowledge of the CDIO- project was very much based on rumours and hear-saying. They found it difficult to distinguish what changes were undertaken in order to meet demands from "inferior" students and the reduction of financial resources, and in order to improve the quality of the program and the students´ employability. Therefore they were worried that the quality of the program, and its´ reputation would be lowered. From their own experiences of project-work in secondary school and work life, they cautioned that project-work was very time-consuming and therefore should not be squeezed in an already tight schedule. The changes they "had heard about" were all planned and implemented by "them" and in the cohorts of 1999 and 2000 there were much rumours about modules being removed, or changed and of the lowering of standards as well as battles between lecturers over scheduled time and student efforts. They considered themselves victims of these changes. In the latter cohorts these complaints were enacted in actions, where the students used their influence to make changes in accordance to their experiences. If we consider this an organisational change process these feelings and actions can be understood as a difference in time perspectives. Management had a long-term perspective of the process, they knew what changes they were planning and why they did it and when they would occur. Each cohort of students came into this process at specific times, and had no history or future vision of what was going on, or why. They reacted when they experienced what they believed were consequences of the planned changes [5] . The meaning of the CDIO-project for management was not the same as for the students. The overall purpose of the CDIO-project was *to foster an approach to teaching where learning outcomes would address disciplinary content as well as personal and interpersonal skills and where process, product and system building skills should be focused. It is expected that teaching should be organised and carried out in an integrated curriculum with a sequence of design-implement experiences in specifically designed work-spaces supporting traditional teaching.* The students´ experiences were that the project-works were not integrated in the curriculum. They were "projects" where they were "allowed" to think for themselves, take responsibility for the outcome of their work, to use and apply previous knowledge. This kind of work was contrasted to "the courses" where tasks were prescribed and time scheduled and knowledge transmitted from lecturers. The project- modules were considered time- and effort consuming, but also very joyful and useful, but also as interfering with their course-work and examinations. Despite this, and the subordinate place these projects had in the overall curriculum, what they had learned in these modules was what they emphasised in their CV.s and job-interviews. Learning to work in teams, design, plan, manage and realise a project were skills and competencies demanded in most work-places, independent of subject-area or business. *The question is what an integrated curriculum means as long as the structuring principles are subject areas and disciplines.*

Conclusions

In this longitudinal study we have followed the process of changing a graduate engineering program, the Y-program, from a traditional, subject- and course based program to a CDIO-program, based on an integrated curriculum and aiming at fostering an *approach to teaching* where learning outcomes should address disciplinary content as well as personal and interpersonal skills, and where process-product- and system building skills should be focussed. From the students self-reported experiences one conclusion is that during the almost ten years of planning and implementing the CDIO-standards, these students did not know very much about the epistemological or pedagogical considerations behind the changes. They associated the CDIO-project very much with project-work scheduled as modules in their curriculums. The students´ *motive*s for enrolling in the Y-program were much related to its´ wide base, meaning they could delay their choice of profile until later, and its´ reputation as "the toughest" and "the best" program. Their *motivation* for carrying this out differed, from being future oriented with hope for good and interesting jobs, to here-and-now oriented with a focus on the joy of studying and being a student. Their motives and motivations influenced their *approaches to studying*, to adjust to and comply to a prevailing curriculum in order to pass their examinations. Their situated conceptions of the prevailing curriculum were much the same in all cohorts. It was conceived of as mainly content-based and teacher focussed [11] [12], at least the first two years, and adjusting and complying was considered necessary to keep up with lectures and examinations and not lag behind too much. For some of the students this was dissonant or incompatible with their personal conceptions of learning [10] [13] and contributed to their loss of study motivation at times. When they, after two-three years, realised that they could "study for learning" they were socialised into acting according to their situated conceptions and did not want to break with old habits, of convenience and of security reasons, you do not let go a winning horse [14]. They had different strategies to manage this dissonance, taking study leaves to do something completely different, to engage in extra-curricular activities or sports and give priority to family and friends outside the program. One could also argue that for the students in the latter cohorts, who were given the opportunity to "behold the light" of a different kind of learning, more aligned with their own conceptions, found it more difficult to adjust to the traditional curriculum, than the students in the first cohort who knew nothing else but hard work and sacrifice.

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