WORKING DAY MODEL FOR STUDENTS IN CHEMICAL AND MATERIALS ENGINEERING

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ABSTRACT

The students' working schedule was modified as part of overall curriculum redesign work in the Chemical Engineering department. The change from a highly detailed, fragmented and classroom-orientated curriculum towards a flexible and working life connected, project-based curriculum is remarkable. The previously applied weekly schedules did not support the new curricula. Teaching was organized in a new way based on the CDIO framework and is now implemented according to a working day model. A working day was planned to include only two subjects. The first subject is studied during the morning session and the second one in the afternoon. This paper introduces the background behind the working day model and the reasons why the program decided to reorganize the studies. The design and the learning objectives as well as the working day model are described.

KEYWORDS

Working Day model, Curriculum Design, Integrated Curriculum, Standards 3, 6, 7, 8

BACKGROUND

The curriculum of the Degree Program in Chemical and Materials Engineering was redesigned to comply with the new requirements and instructions of Turku University of Applied Sciences (TUAS). The main requirement was to create a modular curriculum with entities of minimum 5 ETCS and to thus avoid a highly fragmented curriculum by integrating different subjects to form larger entities. In addition, the strategy of TUAS guided the use of innovation pedagogy (Penttilä et al 2011 and 2013). In our degree program, innovation pedagogy is implemented through the CDIO concept.

Another goal of the curriculum redesign work was to bring the teaching out of traditional classrooms and introduce more modern learning methods for the students. This goal combined with the general reduction in the number of contact teaching hours created the need to rearrange the program in a more creative way. The students were presumed to compensate for the reduction in contact teaching time by doing more independent or group work. This was, however, not the trend noted. With the reduction in the number of contact lessons in the weekly schedules, the students started to get employed outside the university to earn money instead of using the time for self-studies. This was a clear sign that a significant change in the weekly schedules was necessary.

Several other reasons in the background acted as drivers for the schedule change as well. Previous experiences gained in subjects including laboratory work had been encouraging and acted as an incentive towards a change. This previously applied concept included both theory and practical work during one day, whereby the morning started with a takeoff session, including the theory behind the laboratory assignment. The takeoff session was then directly followed by the actual hands-on session. This had turned out to be an efficient combination which resulted in good learning outcomes. Furthermore, the students tend to find this arrangement meaningful and interesting. In general, most students find project work much more motivating than classroom lessons. This concept was expanded to now apply even to the schedules of more theoretical topics such as mathematics.

SHEDULE REVISION BASED ON NEW CURRICULUM

Work according to the new curriculum started in 2014 but without any changes in the students' weekly schedule. The schedule was fragmented and did not support project-form work, which is in a central role in the CDIO model. The results from that trial showed us that the new curriculum needed a revised weekly schedule to support and achieve its full potential for enhanced learning. In accordance with the CDIO framework, students are encouraged to work in projects originating from the surrounding businesses (Sutherland et al., 1996). To enable the students to work in projects as well as to manage a project successfully within the given timetable, the working schedule needs to be flexible. Full working days were reserved for project work. Similar arrangements were made for the personnel working as project coaches. The increasing R&D participation required from the personnel needs planning and consideration in the schedules.

The schedule of the first year students in Chemical and Materials Engineering was totally rearranged during the summer of 2015. The schedule was planned to include only two topics per day and only one topic per day when laboratory, projects or other practical work was included. The revised schedule is presented in figure 1. This arrangement made the implementation of the CDIO-based projects in their full extent possible. The schedule arrangements were implemented into the older students' schedules when applicable.

Monday	Tuesday	Wednesday	Thursday	Friday
Information Manag.	Math	Project	English	Chemistry
English	Chemistry		Information Manag.	Math

Figure 1. The new layout of the revised time schedule

TEAM-BUILDING ACTIVITIES FOR EFFICIENT TEAMVORK

The new curriculum is to a large extent based on student self-studies and group assignments. The role of the teacher in the new curriculum resembles that of a coach; they help the students

onto the right track and support the learning procedure. The large number of group assignments forces students to form teams with functional internal dynamics and a positive team spirit in order to avoid conflicts within the team. To be able to work in teams during studies as well as later in business life, the students need to acquire both soft and hard skills. To enhance the development of both types of skills is a central issue in the CDIO framework. Soft skills are seen as including self-confidence, self-discipline, stress resistance and interpersonal abilities such as co-operation, tolerance of diversity, willingness to do teamwork, and conflict handling and decision making skills. This important aspect was early acknowledged within the program and an effort to strengthen the team spirit among the first year students was made from the first day of studies.

At the beginning of the first semester, the entire group of first-year students together with tutor students and some teachers travelled to a summer camp, “Boostcamp”, to spend 24 hours together. The goal was to introduce the new students to each other in order to avoid conflicts based on prejudice. To leave school premises and to spend time together is an effective way to get people to know each other.

The Boostcamp program was planned in detail to train students in several critical teambuilding issues. The group was divided into smaller teams and assignments such as “the future engineer” and “my strengths and weaknesses” were worked on and the results were presented. The positive result of the camp can today be seen in the way the student teams operate. The team spirit is excellent, the mutual respect amongst group members is high, the attendance at start-off sessions and projects is high and the students know each other. These are all prerequisites for successful teamwork.

LEARNING ENVIRONMENTS AS PART OF THE EXPERIENCE

Most of the learning according to the old curriculum took place in traditional classrooms. Experiments performed in laboratories and lessons requiring computer laboratory work were the only teaching events not using regular classrooms. The new curriculum had to be implemented making use of the existing premises, but several improvements in order to achieve a better learning experience were made.

For the take-off sessions, the traditional tables and chairs in the classrooms were arranged in groups instead of the more conventional layout where the tables are arranged in lines. Small groups consisting of 6-8 students work together from the first day onwards. The idea behind these arrangements was that the students were not allowed to take the traditional position and role of a student sitting passive in lines listening to the teacher standing in front of the class. Innovative and new thinking need inspiring surroundings (Stenroos-Vuorio el al., 2012). The teacher walks between the groups and uses the several whiteboards placed on walls in the classroom for the teaching. All traditional large classrooms were updated with extra whiteboards and new table arrangements. Smaller rooms, where student teams can meet and work on their assignments, were equipped with more comfortable furniture in order to create an atmosphere where reflection, free discussion and sharing of information is encouraged. A smaller, redecorated student team room is in presented in figure 2. This new classroom layout was utilized during the fall 2015 especially by teachers in mathematics and languages.

Figure 2. An inspiring learning environment for team assignments. The pillar in the center of the room can be connected to a laptop to show the same screen to everyone.

STUDENT AND STAFF FEEDBACK ON THE WORKING DAY MODEL

The working day model was created during summer 2015 and first implemented in fall 2015. In order to evaluate the model and to further develop it, a survey was conducted. Feedback was obtained from both students and the academic staff.

The feedback from the academic staff was collected through interviews. Open questions like “your experiences about the working day model”, “has the model effects on learning results” and “what would you change or keep” were asked. As a summary of the positive feedback from the staff, it can be stated that the students were more regularly present during the contact lessons compared to the time before the revised model. The good team spirit shows and the student teams work diligently on their assignments. The students’ independent study skills are improving all the time. However, the staff still hoped for more contact hours during the courses.

Even there was positive feedback, there are, according to the staff, several issues which still require attention. The students’ attendance between 8 a.m. and 4 p.m. has improved remarkably, but is still not actualized for all students. Methods to even more deeply engage students need to be developed. Some students have still not realized their essential role in a team and the consequences the team faces when some members do not participate in the work. Another issue identified was the amount and quality of written instructions available for the students. As the students are obliged to work independently or in groups, carefully drafted instructions play a more important part in the learning procedure than when the teacher was available to answer questions. A third issue identified concerned the premises available. Even though efforts to modernize the classrooms were made, there is still more work to be done. In particular, there is dire need of smaller team rooms and a proper booking system for these needs to be developed.

The student feedback was obtained by means of a survey conducted at the beginning of the spring semester when the students returned from their Christmas break. The survey consisted of two parts. The first part contained multiple choice questions while the second part collected open response opinions.

1. How many hours have you been studying during the working day 8:00-16:00?
    a) 5 h/day, 25 h/week
    b) 6 h/day, 30 h/week
    c) 7 h/day, 35 h/week
    d) 8 h/day, 40 h/week
    e) 4 h/day, max. 20 h/week
    f) < 20 h/week

2. How many hours have you been studying outside the working day 8:00-16:00?
    a) 1-5 h/week
    b) 6-10 h/week
    c) 0 h/week
    d) >10 h/week

3. What is your experience about the model?
    a) OK
    b) Too laborious!
    c) What model?

4. Has the amount of teacher guidance been sufficient in your opinion?
    a) No. Please explain.
    b) Yes. Please explain.

5. Have you been working besides studying? If yes, what have your working hours been?
    a) Weekdays in the evening
    b) Weekdays during the day
    c) At weekends

The open response section of the survey asked the following question: What would you keep and what could be changed in the working day model?

Table 1. Survey of Working Day model – outcome based questions (n=28)

1. How many hours have you been studying during the working day 8:00-16:00?	Answers
a) 5 h/day, 25 h/week	2
b) 6 h/day, 30 h/week	**10**
c) 7 h/day, 35 h/week	**9**
d) 8 h/day, 40 h/week	7
e) 4 h/day, max 20 h/week	0
d) < 20 h/week	0

Table 2. Survey of Working Day model – outcome based questions (n=28)

2. How many hours have you been studying outside the working day 8:00-16:00?	Answers
a) 1-5 h/week	5
b) 6-10 h/week	**11**
c) 0 h/week	1
d) >10 h/week	**11**

Table 3. Survey of Working Day model – outcome based questions (n=28)

3. What is your experience about the model?	Answers
OK	9
Too laborious!	10
What model?	9

Table 4. Survey of Working Day model – outcome based questions (n=28)

4. Has the amount teacher supervision been sufficient in your opinion?	Answers
No	16
Yes	12

Table 5. Survey of Working Day model – outcome based questions (n=28)

5. Have you been working besides studying? If yes, what have your working hours been?	Answers
a) Weekdays in the evening	2
b) Weekdays during the day	1
c) At weekends	3

An observation that arises from the survey results is that most of the students answering the questionnaire have spent between six and eight hours a day at the university. This is well in line with the planned 8-16 working day model. The time spent studying has continued even though the school day ended for most of the students. Most of them spent six hours or more studying also in the evenings. The question concerning the sufficiency of teacher supervision divides the answers into two groups. A small majority finds the amount of supervision insufficient while the other half is satisfied with the amount supervision available. When the feedback from the “insufficient supervision” group is more closely investigated, one major finding, which also the staff interviews identified, is that there is lack of adequate material to support self-studies.

Material supporting self-studies can already be found for all topics. Though, the material available in the student material storage need to be organized into larger entireties. The organization of the material should make it easier for the students to associate the material with a certain assignment. The information can for the moment be experienced as fragmented and unorganized and not supporting self-studies.

The second part of the student survey collected open response opinions. The questions were “what would you keep in the working day model” and respectively “what would you like to change in the working day model”. Almost 50 % of the students answering the open questions preferred the working day model prior to the more fragmented schedule. Only 10 % of the answerers declared they preferred normal school class teaching hours. By this the answerers meant in general two-hour lessons with the teacher lecturing in the front of the classroom. They experienced that the largest problem with working day model was the lack of adequate teaching contact time in combination with their experience of not enough self-study material and instructions available. Also problems like too much information in too high tempo and unclearness when the teachers are available for guidance outside the contact hours, were mentioned.

Self-directing learning has been discussed in detail by McLoughlin & Lee (2010). They claim that learning experiences that are made possible by social software tools are active and anchored in and driven by the students' interests. The method will then support independent learning. Self-directed learning (Biggs, 1987; Zimmerman & Schunk, 1989; Simons 1992) refers to the ability of the student to prepare for his/her own learning, take the necessary steps to learn in her/his own tempo and manage and evaluate the learning as well as provide feedback and judgment. All this can be achieved while simultaneously maintaining a high level of motivation

The data was collected and analyzed for two main purposes. Firstly, it is valuable to collect data and experiences in order to further develop the working day model based on the reactions of both personnel and students. The second reason was to review the student comments on the issues they regarded as reasons why the model in their opinion is not working. This information can be used in further guidance of the students. Also the positive comments are noted and further communicated. It is important to identify and communicate the benefits of the model as well as the issues identified as requiring further development. In particular, issues such as lack of adequate material and self-study examples need to be addressed promptly.

CONCLUSIONS

In this paper we have presented the working day model implemented for the first year students in Chemical and Materials Engineering. The department of Chemical and Materials Engineering started the work towards CDIO adaption already in 2010. The first step towards CDIO adaption was a first-year introduction to engineering course included in the curriculums. From these days have the curriculums been revised to include all steps needed to follow the CDIO strategy.

The working day model support the new curriculum better than the fragmented weekly schedule. The feedback after a half year implementation time of the model was collected. Several encouraging and expected findings were noted as well as parts where more development work needs to be done. One positive finding was a notable change in the time the students spent in school studying. Group assignments are scheduled in the weekly time table and thereby made in school. Among the first year students has the amount persons working besides their studies decreased remarkably. It needs to be followed up whether this finding is directly linked to a faster graduation process. Also the good team-spirit among the first year students is worth mentioning. Special efforts were put into teambuilding as this is the base for well working groups. Efforts need to be allocated to organization of material supporting self-studies as well as assignments instructions. The working day model will be further

developed and the development plan will include statistical information about passing rates of courses as well as student grades.

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