# FOCUSING ON CREATIVITY: FACULTY MOTIVATION IN TEACHING BRAIN-STORMING AND CREATIVITY IN AN INTRODUCTORY COURSE

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## ABSTRACT

At Reykjavik University (RU) we run an introductory course for all engineering students in two phases: a two-day „brain-storming“ event focusing on creativity, early in the first semester, and a three-week intensive course focusing on design at the end of the semester. In the brain-storming phase, almost all faculty members in the School of Science and Engineering (SSE) take part and act as tutors. Their role is to stimulate and encourage the students. Participating in this course puts many of the faculty into a new role and their reaction has ranged from very enthusiastic and interested to reluctant, critical and even drudging. A survey on faculty opinion shows that they are very supportive of introducing creativity into the engineering programs, as implemented by the brain-storming days. On the other hand, a significant fraction of the faculty considers their time not well spent in participating in the course. The SSE has two options, firstly to continue in a similar way with all faculty involved or to ask only those interested to take part in the course next time. We conclude that it is important that participating faculty become more involved and are given the opportunity to influence the course's development as well as training in relevant teaching methods.

## KEYWORDS

Creativity, brain-storming, introduction to engineering, educational changes, standards: 1, 4, 8, 10.

## INTRODUCTION

CDIO (Conceive-Design-Implement-Operate) is a widespread model for improving engineering education. Implementing CDIO into an already established teaching program calls for a number of changes in the education process, e.g. faculty adoption of the CDIO context (standard 1), an introductory course that provides the framework for engineering practice and introduces essential personal and interpersonal skills (standard 4), active experiential learning methods (standard 8), and enhancement of faculty competence in providing integrated learning experiences (standard 10).

### *Creativity in engineering*

It is a demanding responsibility of universities to educate engineers for the future and the unknown challenges they will face later in their career. Many of them will be put in positions were they need to think globally, be open to new ideas and opinions, and will be expected to work efficiently in diverse teams to come up with new creative solutions facing different societies. All too often, engineering education focuses mostly on the technical expertise, which is of course fundamental to engineering, but their education also needs to provide them with

the mind-set to be creative and work in multidisciplinary teams (Crawley, Malmqvist, Östlund, Brodeur, and Edström, 2014, Kamp 2014).

To generate ideas is the foundation of creativity, and brain-storming is a well know technique for fostering creativity, whereby a group of people create ideas as a part of problem solving. Brain-storming techniques have been used successfully in various industrial and educational settings, i.e. sciences and engineering (Fang, 2013).

### *Commitment of faculty to changes in education*

Changes in education are a complex process that builds on work carried out at many different levels, e.g. in the classroom, the teacher's work outside the classroom, at the school management level and state policy. Fullan (2000) emphasises that large-scale changes must be implemented in cooperation with, and supported by, all stakeholders, including teachers and school authorities, and everyone needs to take an active part. To implement changes in education as CDIO calls for can be difficult and demands that both the institution and faculty react efficiently and successfully. The burden of changes affects not only administration, but also teachers, because their roles are crucial and their abilities and attitudes are important (Maskit, 2011). The experience of implementing CDIO can be different at different universities. Lee et al. (2015) compared the experience of five universities in four countries, and stated that the change of faculty's mind-set is one of the biggest challenges, as well as achieving "buy-in" of the faculty. Quite a few sceptical reactions were revealed.

Fullan (2007) lists three perspectives to reflect on when introducing new things in education: "(1) the possible use of new or revised material (i.e., instruction resources such as curriculum material or technology), (2) the possible use of new teaching approaches, (i.e., new teaching strategies or activities), and (3) the possible alternation of beliefs (i.e., pedagogical assumptions and theories underlying particular new policies or programs)" (p.30). Changes initiated by implementing CDIO are related to all three perspectives. The faculty's reactions can range from being positive and eager to take part in the new pedagogy, to negative and critical attitudes and even fighting against the changes. Based on the above studies, positive and supportive attitudes among faculty are essential and extremely important for the successful implementation of CDIO.

## A COURSE ON CREATIVITY THROUGH BRAIN-STORMING

SSE at RU has been adopting the principle of CDIO is the context of engineering education. There are many things to consider when planning an introduction to engineering course and creativity and engineering design are certainly among the issues that should be in the curriculum. SSE runs an introductory course for all first-year engineering students in two phases: a two-day „brain-storming" event, early in the semester, focusing on creativity i.e. the "C" in CDIO; and then a three-week intensive course, at the end of the semester, focusing on engineering design (Audunsson, Saemundsdottir, and Matthiasdottir, 2015).

In this paper the focus will be on the first phase of the course, i.e. the brain-storming event, as it was run in the fall of 2015. One of the main objectives of this course is to give students a chance to become acquainted with other students and faculty, making them more comfortable in their study environment and thus hopefully lowering the drop-out rate. The learning outcomes (LO) all focus on personal and interpersonal skills, i.e., at the end of the course the student should:

1. Have experienced teamwork and understand the importance of cooperation and diversity in a working group.
2. Have experienced an organized approach to brain-storming.
3. Have experienced diversity in the presentation of solutions.

The brain-storming days started in the fourth week of the fall semester in 2015, on late Wednesday afternoon, when the students got a brief presentation of the project they were supposed to work on the next day, and exhibit their solutions the day after that. The project was kept a secret until Wednesday afternoon and was presented to students and faculty at the same time. The next morning, Thursday, 208 first year students were divided into groups of five to six students each and introduced to the basic rules of brain-storming, followed by a brain-storming session and selection of ideas to continue to work with during the day.

Most students are used to well-defined assignments that all too often have only one solution. To prepare the students for the challenge of the upcoming studies, as well as to change their mind-set into thinking that there can be many solutions to a problem, the method of brain-storming was utilized. The aim was to teach students how to approach the idea phase of a project in an organized manner, as well as to demonstrate to them the advantages of working in a group.

Brain-storming has been a popular method used by the industry in different fields for some years. It is normally used in the initial phase of a project or during the project duration to solve a specific problem. One of the reason for its popularity within some industries is for example due to the creativity aspect of the method. By using brain-storming, many new ideas are generated by different types of stakeholders and the most valuable one is then chosen to continue to work with.

By introducing this method to students in the beginning of their engineering studies they are taught a method they can use throughout their studies. Brain-storming makes sure that all ideas are considered, for those students that are not as talkative as others this can be beneficial since all voices are heard. The group will have to reach an agreement on which idea to continue to work with so the method brings the group together and is a perfect way to start group work.

### *The brain-storming process*

The brain-storming session was divided into the four following steps:

1. *Defining the problem or the project*

   The project in the last year´s course was a national stadium in Iceland, a much discussed and disputed topic at that time. The year before, the project was a bridge across the bay where the university campus is situated. Both projects were related to current issues that had been widely covered in the media, and most students related to these projects as relevant issues.

2. *Brain-storming*

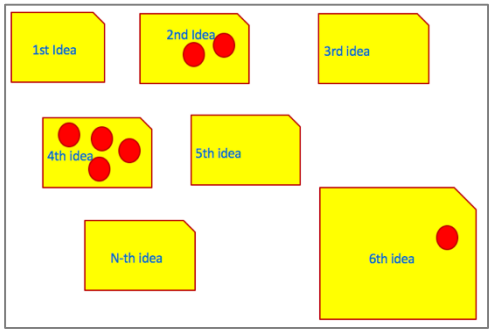

At this stage, the students were encouraged to generate as many ideas as possible regarding the topic for 15 minutes. They wrote each idea on a single post-it note and it was greatly emphasised that all ideas were welcomed – no idea is too "stupid". The purpose of this step was to allow each student to speak his or her mind and to participate, since it is often a problem in group work that only one or two persons dominate the idea phase. The main rules during the brain-storming process, originally from Osborn (1953), are:

- No criticism, all criticism of the ideas that are generated should be put on hold.
- Quantity is desirable, the more ideas the more likely an effective solution will be found.
- Think "up", wild ideas are especially welcomed; generating a good and long list of ideas is preferable.
- Combine and improve ideas (1 + 1 = 3 rule).

3. *Collecting and classifying*

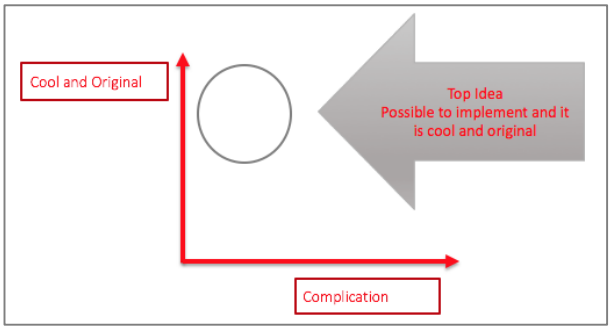
One student per group got the role of table manager, he or she should classify similar ideas. The purpose of this stage was to narrow the focus, and to combine and improve ideas.

4. *Prioritizing and selecting*




The ideas were prioritized in two ways, with the aim of finding the "best" idea to continue to develop and promote at the exhibition the last day of the course. Firstly, all group members received three circular stickers and were asked to put them on the idea or ideas they liked the best. They could either put all three stickers on one idea, or divide their stickers between ideas.

Secondly, a graph had been put on each group´s table with the X-axis labelled as "Complicated", meaning how easy or difficult it was to implement and promote the idea; and Y-axis labelled as "Cool and Original", to encourage the students to think outside the box.




In this final step of the brain-storming, criticism was welcomed. The students, who had gotten to know each other a bit better at this point, were encouraged to speak up for the ideas they preferred and present the group with arguments for evaluating the pros and cons of each idea.

Figure 1 shows students working in the brain-storming session.

Figure 1. Group work in the brain-storming session.

*5. Further work*

Thursday afternoon, after the brain-storming session, students worked in groups on developing the idea they had decided on, to some extent guided by faculty. They presented their solutions at noon on Friday, mostly by showing models, posters and/or videos. The students did not get any formal feedback on their work but a committee chose and rewarded the "best" three projects. The students gave feedback on the course and the course evaluation was rather positive, or 4.12 (on a scale from 1 to 5).

Almost all SSE´s faculty took part in the brain storming days and acted as tutors, each teacher responsible for one to three groups. Their role was to guide students through the project without "to much" support, not at all to solve the tasks or give them the "right" ideas. The faculty acted both as facilitators and activators and the students took responsibility for setting goals and for the results of their work. Many of the faculty were placed in an unfamiliar situation, they were no longer teachers in the role of leading student´s work in the classroom and guiding them towards well-known solutions, instead their new role was to stimulate and encourage students to seek their own new solutions. The reactions of the faculty to this new task, based on a discussion at an informal meeting held after the course, ranged from being very enthusiastic and eager to being reluctant and passive.

## SURVEY ON FACULTY ATTITUDES

It was decided to run a small survey among the SSE faculty, with the objective of gaining a better understanding of the faculty's attitudes toward the brain-storming days. From now on the two-day brain-storming phase will be referred to as the course.

### *Method*

A total of 50 faculty members at SSE were approached and 23 (46%) of them participated and answered a questionnaire. When asked how often they had participated in the course, 17 (74%) had participated twice, three (13%) once and three (13%) never.

A questionnaire was designed especially for this survey and consisted of 22 statements on a five point scale (from totally disagree to totally agree) about attitudes towards the course and its implementation. At the end of the questionnaire there were three open questions, two about what the participants considered to have been successful and not so successful, and one open space for any other comments. The survey was online in a system called FreeonlineSurveys (http://freeonlinesurveys.com/) and the faculty received an e-mail from the SSE office asking them to participate. The survey was conducted in January and February 2016 and was open for three weeks, a reminder was sent to all after one week.

## RESULTS

Table 1 shows the faculty's attitudes toward four of the statements in the survey. Majority (86%) of the respondents claim that creativity is important in the engineering programs at SSE, and just over 62% feel that the current implementation of the course is acceptable.

Table 1. Faculty's attitudes towards teaching creativity and towards the course in general.

| | Totally agree and agree N (%) | Neutral N (%) | Totally disagree and disagree N (%) |
|---|---|---|---|
| Creativity should be an important factor in the engineering programs at SSE | 19 (86%) | 2 (9%) | 1 (5%) |
| It is a good initiative by SSE to run this course | 14 (67%) | 3 (14%) | 4 (19%) |
| I believe that this course is important for SSE | 13 (62%) | 3 (14%) | 5 (24%) |
| The projects in the courses are encouraging and provided scope for creativity | 13 (65%) | 4 (10%) | 3 (15%) |

Table 2 shows the faculty's attitudes toward six statements regarding students and LO. Overall, the majority of the faculty is of the opinion that the LO of the course were fulfilled. A few faculty members are of the opinion that students do not benefit from the course.

Table 2. Faculty's attitudes towards the objectives and LO of the course.

| | Totally agree and agree N (%) | Neutral N (%) | Totally disagree and disagree N (%) |
|---|---|---|---|
| Students have the opportunity to get to know each other well in this course | 15 (75%) | 3 (15%) | 2 (10%) |
| Students learn about teamwork in this course | 17 (85%) | 3 (15%) | 2 (10%) |
| Students learn about the importance of cooperation in this course | 13 (65%) | 4 (20%) | 3 (15%) |
| Students are introduced to an organized way of gathering and assessing ideas in this course | 13 (65%) | 5 (25%) | 2 (10%) |
| Students learn about a variety of ways of presentations in this course | 10 (50%) | 6 (30%) | 4 (20%) |
| I believe that students do not benefit from this course | 3 (15%) | 3 (14%) | 15 (72%) |

Table 3 shows the faculty's attitudes towards twelve statements about their own involvement in the course. A majority (62%) of the responding faculty are happy to participate in the course, feel it is well organized (70%) and do not feel it is a failure (71%). Just under half (47%) of the participants wants to take part in further development of the course.

Table 3. Faculty attitudes towards their own involvement in the course.

| | Totally agree and agree N (%) | Neutral N (%) | Totally disagree and disagree N (%) |
|---|---|---|---|
| I participate happily in the course | 13 (62%) | 4 (19%) | 4 (19%) |
| I find this course well organized | 14 (70%) | 3 (15%) | 3 (15%) |
| I feel excited not knowing anything about the project until it begins, just like the students | 7 (33%) | 7 (33%) | 7 (35%) |
| I find this course rewarding for me as a teacher | 6 (30%) | 7 (35%) | 7 (35%) |
| I want to participate in developing this course further | 7 (47%) | 2 (13%) | 6 (40%) |
| I find this course to be a failure | 5 (24%) | 1 (5%) | 15 (71%) |
| I find the course too long | 4 (19%) | 5 (24%) | 12 (57%) |
| I need more guidance about my role as a facilitator in this course | 6 (29%) | 8 (38%) | 10 (48%) |
| I believe this course support to the courses I teach | 5 (24%) | 7 (44%) | 6 (38%) |
| At first I had doubts about this course but not anymore | 2 (13%) | 8 (38%) | 8 (38%) |
| I feel we need a formal assessment in this course | 3 (15%) | 6 (29%) | 12 (58%) |
| I think my time is poorly spent as an instructor in this course | 8 (38%) | 2 (10%) | 11 (52%) |

Nine participants answered the open question about what went well in the course. The remarks emphasise how well the students worked, and that the first-year students had the opportunity to get to know each other and the teachers. This quote is representative of their comments: "Overall a very good course and necessary to break up the semester. This course helps me definitely to give students the idea that they are in an exciting study program". The respondents liked the emphasis on creativity and one said that the initial introduction to the course on Wednesday had been convincing and inspiring, and that the course was well organized. One especially praised the brain-storming session and said it was fantastic.

Nine of the participants gave their opinions on what had not been successful in the course. Many comments were related to how faculty's time was wasted, especially in the introduction at the beginning and at the students' exhibition at the end. One criticized the lack of formal feedback to students at the end of the course.

When asked if they had something to add, 12 answered and the comments were both positive and negative. Four were very positive and thought this was a great initiative. As before the negative comments were that faculty time was not well spent and the evaluation of the students work could be better. This quote is representative of their comments: "This course is good, but

it should take into account that the staff has many other things to do and it is not acceptable to let them sit long lectures they benefit nothing from".

## DISCUSSION

Faculty's motivation and support is always important, especially when offering a course which is supposed to inspire students to be creative, such as the brain-storming days. The faculty must be prepared to teach a curriculum emphasising personal and interpersonal skills and active learning with problem solving activities, team work, brain-storming and discussions. Overall, the survey indicates positive attitudes towards the course, LO, the organisation and students' experience. A vast majority of the respondents in the survey supports the idea of stimulating creativity in the engineering programs, as implemented by the brain-storming procedure, although, firm conclusions cannot be drawn from the results due to the relatively low response rate.

Despite this faculty members were not as positive towards their own roles in the course, and too many felt that their time was not well spent. One possible reason for this was reflected in the participants comments; they see themselves principally as researchers and specialists; research leads to promotion and, as researchers, they regret anything that takes time away from their research. As specialists, they find it more rewarding and feel most comfortable teaching specialised courses within their own field of specialization. For many, teaching personal and interpersonal skills, is neither within their field of interest nor their field of competence. This is something the organizers of the course need to address.

It is disappointing that a relatively large proportion of the respondents seem "neutral" regarding their own involvement in the course. This can mean that they are not interested in their roles in the course. Only on third said they found the course rewarding to themselves as teachers and one fifth said that the course supported other courses that they taught, although the LO address skills that should could apply to many courses. The organisers of the course clearly need to put more effort into stimulating active interest among faculty and possibly by more involvement in implementing the course.

In short, the faculty seem to like the idea of stimulating creativity among first year students by the brain-storming days, but they are not as keen on being active in running and developing the course.

From the survey it can be concluded that there are two options for the organisation of the course:

- All faculty members participate in the course each year, each member tutoring one or two groups. If so, then a campaign to motivate faculty is necessary.
- Only a part of the faculty participate in the course each year, teaching "full-time" during the two days, i.e. each tutoring four to six groups.

Either way, the SSE needs to prepare faculty for teaching personal and interpersonal skills and coach them for teaching in these new circumstances. It is important to give all faculty an opportunity to influence and participate in the development of the course in order to give them a sense of ownership in the course and make them more engaged in their roles as tutors.

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