Experts in Teams – An experiential learning method

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ABSTRACT

This study discusses the pedagogical characteristics of the hands-on interdisciplinary innovation course Experts in Teams (EiT) of the University of Southern Denmark (SDU).

EiT is a 10 ECTS course mandatory to all fifth semester students on any engineering program at the Technical Faculty of SDU. Course duration is 12 weeks with two weekly sessions of which only one is teacher controlled. In 2016 EiT involved approximately 425 students, 22 teaching resources, and 6 companies. These numbers will increase in the years to come.

Traditionally we distinguish between practical courses and theoretical courses. Most of the practical courses are group work along the lines of project based learning. EiT is in a way both. It is a practical course in as much as our students get hands-on experience with interdisciplinary team work and innovation processes. EiT is a theoretical course in as much as our students are taught various tools that aid and guide them in the innovation process and in the interdisciplinary team work.

The theoretical foundations of EiT viewed as a teaching method is experiential learning and its derivative project based learning. In the beginning of the 12 weeks course period EiT is taught much like a traditional theoretical course. After only a few weeks this all changes and the teachers become facilitators of the students' own learning which is relevance-steered by the innovation project at hand. These characteristics are typical for experiential learning and in this way EiT becomes a learning method rather than a teaching method.

Besides discussing the pedagogical characteristics of EiT, the study also gives a general introduction to EiT as it was taught at SDU fall 2016 as well as a brief review of the basic theory behind experiential learning. As such this study serves both as an introduction to e.g. new teachers of EiT but also as a starting point for a clarification of the features that makes EiT an experiential learning endeavor.

Keywords - hands-on innovation teaching, interdisciplinarity, teaching method, learning method, experiential learning, project-based learning, Kolb's learning theory

I INTRODUCTION AND MOTIVATION

In 2001 a new course named "Eksperter i team" or in English "Experts in Teams" (EiT) was launched at NTNU in Bergen (Sortland, 2015) (NTNU, 2016). Since then several other universities in Scandinavia have installed similar courses – all inspired by the NTNU course.

At the Technical Faculty (TEK) of the University of Southern Denmark (SDU) EiT was launched in 2006. EiT is mandatory for all students of TEK, i.e. all SDU engineering students and is placed on their fifth semester. For students from other faculties the course is an elective. Our students work in interdisciplinary and preferably cross-cultural[1] teams on an innovation process (or at least parts of it). The course is very hands-on and learning-by-doing and it is so in a student-directed way with little lecturing and only a small

[1] Here I take 'cross-cultural' to mean 'international' (more or less).

amount of prescribed literature. Essentially EiT at TEK/SDU is very similar to EiT at NTNU though at TEK/SDU we emphasize a bit more the innovation part of the course at the expense of the facilitation part (more on this later on).

At TEK/SDU EiT is a consequence of the "The Engineering Education Model of the University of Southern Denmark" (DSMI) - an education model that goes for all engineering programs at TEK/SDU[2]. Among the drivers for DSMI is a perceived demand from society to turn to good account the many hours our students spend at obtaining their diplomas by endowing our students with employability skills and competences of a more general character.

Obviously EiT at TEK/SDU is not a conventional university course. The features described above set it apart from the traditional teacher directed university courses with a well-defined course curriculum and course syllabus. The question as to what kind of teaching method EiT is naturally arises. The answer, I suggest, is that EiT is an experiential learning method.

In the following I will try to describe in more detail the characteristics of EiT as a teaching and learning activity. At the same time I will highlight important elements of the organization of EiT at TEK/SDU. Knowledge of experiential learning theory is required in order to appreciate the experiential dimension of EiT. Therefore I will start out by giving a very brief introduction or brush up to this topic. After the introduction of the theoretical framework I turn to the practical aspects of EiT as it is implemented at TEK/SDU. Finally I discuss the characteristics of EiT that identifies it as an experiential learning course.

II EXPERIENTIAL LEARNING

Introduction

It comes as no surprise that EiT fits the characteristics of a project-based learning (PBL) method well – after all PBL is mentioned in DSMI. Somewhat less trivial is the notion of EiT relying on experiential learning to achieve the learning outcomes. What exactly does this entail? What are the foundations of experiential learning? And what is e.g. the difference between experiential learning and PBL?

Kolb's experiential learning theory

Back in the 1970s Kolb and Fry developed the basics of what is now known as the experiential learning model (Kolb & Fry, 1975) (Kolb, 1984). The model is typically illustrated as shown in Figure 1 (Chapman, 2013) where the black boxes represent stages in the learning cycle, the red boxes are associated learning styles, the blue box with arrows represent a processing continuum (doing or watching), and finally the green box with arrows represent a perception continuum (feeling or thinking).

Learning is seen as a continuous process where individuals are actively involved in new experiences, reflect on what has taken place, theorize about the experience, and finally apply this knowledge to new situations (Kolb, 1984). Kolb focuses on the process of learning and not on the concrete learning outcomes and talks about knowledge as created through the transformation of experience.

[2] In the following I will consider only the TEK study programs of campus Odense. TEK/SDU has a campus also in Sønderborg where the students of course also have EiT. EiT Sønderborg is, however, a course separate and different from EiT Odense.

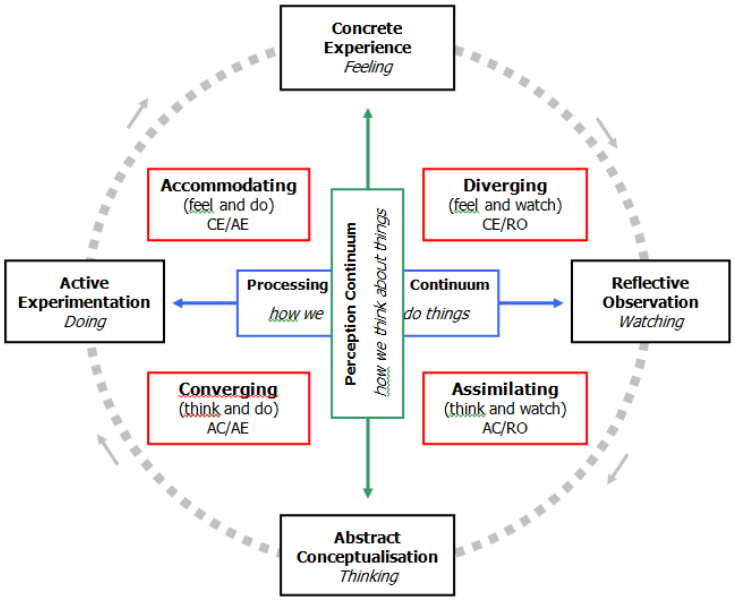

Figure 1: Illustration of Kolb's learning model (Chapman, 2013)

It is beyond the scope of this study to give a full interpretation of Kolb's theory. Here I shall emphasize the two relatively trivial facts that: 1) experiential learning begins and ends with the students active involvement in an "experience" and 2) that deliberate and explicit reflection on the actual outcome of the experience as opposed to the believed outcome prior to the experience is of paramount importance to consolidate new knowledge (Association for Experiential Education, 2007-2017) (Kolb, 1984) (NTNU, 2016).

Project-based learning

Experiential learning takes many forms (Garlick, 2014). Of particular interest to this study I shall mention *problem*-based learning and *project*-based learning where the latter can be seen as a further development of the former. In the literature both are referred to as PBL-methods.

Problem-based learning is an approach that involves real-life problems and their solution. The focus is not on how to apply certain methods to a given problem – that would be the traditional way to go about it. In problem-based learning the focus is on determining e.g. what methods are appropriate to solve a particular problem – which may well involve self-learning of those methods. Supposedly it therefore develops the skills of reflection, reasoning, and observation as opposed to just being presented to and collecting facts (Garlick, 2014). The problem itself could also be developed or refined by the student.

When the problem takes on a project-like character and starts to consume a substantial amount of time then the problem-based learning becomes project-based-learning. Clearly the scope of a "project" is wider than the scope of a "problem". The "project" may involve several problems and require multiple methods and lots of project-specific knowledge.

PBL, be it problem or project based, are not intrinsic group-work methods, and it is entirely possible to do PBL as an individual activity.

Learning outcomes and experiential learning

The curriculum is replaced by reflection on the "experience" the student have had during the course (NTNU, 2016, p. 16). Reflections on an "experience" leave ample room for the actual learning outcomes to be very different from student to student and they become subjective in the sense that they depend on

the individual experiences of the students. In general this means that the learning outcomes of the course description of an experiential learning based course will be much less tangible – border lining vague - than the learning outcomes of a traditional curriculum based course.

Teacher versus facilitator

With subjective student dependent learning outcomes clearly also the teacher role of experiential learning must be very different from the teacher role of a curriculum based course. The teacher's role will no longer be that of presenting e.g. theories to the students. Instead the teacher role becomes that of a facilitator. During experiential learning, the facilitator's role is to (Association for Experiential Education, 2007-2017):

- Select suitable "experiences"
- Pose problems, set boundaries, support learners, provide suitable resource, ensure physical and emotional safety, and facilitate the learning process.
- Recognize and encourage spontaneous opportunities for learning, engagement with challenging situations, experimentation (that does not jeopardize the wellbeing of others) and discovery of solutions.
- Help the learner notice the connections between one context and another, between theory and the experience and encouraging this examination repeatedly.

Critique of experiential learning

It should be noted that not everybody agrees that experiential learning is all it claims to be. Apparently research shows that only when a sufficient level of prior knowledge is reached does experiential learning provide a better alternative than the traditional curriculum base courses with guided instruction are almost always superior (Kirschner, et al., 2006).

Besides the more theoretical considerations of the problems with experiential learning, students and professors alike also complain that PBL in general leads to redundant research and non-constructive speculation (Provan, 2011).

III EXPERTS IN TEAMS: THE COURSE AND ITS ORGANISATION AT TEK/SDU

Introduction

The following section describes in some detail the organization of the course EiT at TEK/SDU. The course I deeply rooted in "The Engineering Education Model of the University of Southern Denmark" (DSMI) - an education model that all engineering programs at TEK/SDU adhere to (SDU/TEK, 2015). DSMI is discussed first and then the actual organization of EiT fall 2016 is discussed.

DSMI

The purpose of DSMI is to establish a foundation for the engineering programs at TEK/SDU. It is both a model and a strategy for how to construct an engineering education program. As a strategy it seeks to ascertain that the skills and competencies of the SDU engineers comply with market demand. As a model it outlines the organization and constituent components of an SDU engineering program.

Albeit recognizing the importance of traditional theoretical lecturing courses, the model puts emphasis on active and project based learning. On each of the first 4 semesters of any engineering program at SDU, 10ECTS are reserved for a semester project. In the semester project the students do project based group work on real-life problems. The semester projects let the students work with the theoretical content of the semester in an applied way. On the 5th semester EiT takes the place of the semester project. The students

are put in interdisciplinary groups and asked to work with real-life innovation. There is no overlap, except by coincidence, between the EiT project content and the rest of the courses the students are taught on that semester.

The project based learning approach reflected in DSMI is considered not only to facilitate deeper learning of the semesters' theoretical content but also to strengthen general skills and competences. The following general skills and competences are mentioned in DSMI (SDU/TEK, 2015).

Engineers trained at SDU must have the capacity to:

- Work independently and be able to:
  - Plan strategies for their own learning process
  - Evaluate their own learning process
  - Focus in-depth on technical disciplines
  - Formulate and analyse a problem in a structured manner
- Cooperate and be able to:
  - Work in an interdisciplinary context
  - Work with people from other academic and cultural backgrounds
  - Document and communicate their knowledge and results verbally and in writing to different target groups
  - Evaluate the work of others and give them feedback
  - Work in a project-oriented context and in teams
- Apply their knowledge, skills and competencies in practice and be:
  - Receptive towards new problems and solutions
  - Innovative and creative
  - Solution-oriented

These general skills and competencies are all clearly targeted by the semester projects and EiT in conjunction with EiT covering the interdisciplinary and innovative competencies.

A progression in openness of the semester projects is intended with DSMI. At the first semester the problem of the semester project will thus be fairly closed while it will open up more and more during the following semesters. Clearly this also leads to a progression in student-directedness and on the fourth semester the students may even be responsible for formulating the problem of their semester project and seeking the necessary information to solve it themselves, i.e. on the last semesters the students' work with the semester project comes very close to experiential learning.

The semester projects and EiT are the ECTS points that most obviously target the general skills and competences of DSMI mentioned above. Of course students also work their core subject skills and competencies in the semester projects but in EiT this changes somewhat.

Organization of EiT

EiT at TEK/SDU is a 10ECTS mandatory course for all engineering students at the fifth semester. Exchange students usually visit at their fifth semester and most of them take EiT corresponding to 5-10% of the total number of students on the course. Occasionally also a couple of students from other faculties might choose EiT but they do not constitute any significant group.

The course thus far only runs in the fall – mainly because all engineering programs start after summer. All fifth semester time tables have Wednesdays' and Thursdays' afternoons reserved for EiT from 12.15-15.45. Wednesdays are teacher controlled whereas the students are on their own on Thursdays. The time slot on Thursdays is reserved in the timetables to make certain that students from different programs have opportunity to meet and work together.

The students of EiT at TEK/SDU, counting hundreds, are divided into themes of around but preferably not above 40 students per theme. The themes are introduced to the students on the first day of the course and each student is invited to prioritize 3 themes. The students' preferences determine in which theme they are placed. Of course promotion of interdisciplinarity and cross-cultural group work must also be taken into account. Therefore an ad-hoc maximum on the number of students from the same engineering program in a theme is used. Likewise exchange students are divided equally among the themes. Not all students will therefore be given their first priority theme - but in the order of half the students half will. The rest will be given their second and third priority theme with only a few being given the latter.

In the themes the students are again divided into teams of 5-6 students. Also here interdisciplinarity is ensured by allowing only two students from the same program in each group. Likewise exchange students are distributed evenly among the groups. The groups must be formed in week 2 of the course. There is no central policy on how to form the groups and the teachers can use whatever method they see fit. In some themes it is left for the students to decide for themselves, in some themes the teachers simply decide, and in some themes some other method is preferred. Some students always complain that the group formation process could have been better.

Two teachers are allocated to each theme. They are ultimately responsible for the theme curriculum although the curriculum is being developed in strong collaboration with the EiT coordinator.

Examination

The students hand in a series of deliverables at the end of the course. Together with an individual oral defence and a group presentation those deliverables are evaluated and an individual grade is passed. The deliverables count an individual learning report and 3 group hand-ins: a concept and skills poster, a collaboration poster, and a business report.

Learning outcomes

To walk through the individual learning outcomes of EiT is beyond the scope of this study. It suffices to say that they all target the general skills and competences of DSMI mentioned above which also makes them somewhat intangible and vague. The course description mentions innovation process and interdisciplinary team work to be at the main "experiences" of the course - all very much along the lines of experiential learning as I shall discuss later on.

The EiT themes

Two factors shape our themes:

1. the overall course objective that our students should encounter real work-life innovation processes and
2. the requirement that in the ideation phase of the course all students should be able to bring their core study-program competencies into play.

Since the vast majority of our students are students of engineering the above mentioned factors reduce to (at least) requiring of the themes that they should be engineering relevant, i.e. they should deal with the types of problems that engineers would normally encounter "out there".

We use the two concept pairs *entre*preneurial/*intra*preneurial and push/pull to classify our themes. In *entre*preneurial themes the students work with start-ups, i.e. they qualify their value propositions assuming that they are a start-up company. In *intra*preneurial themes the students work with innovation within an existing company, i.e. they qualify their value propositions on behalf of the company.

Typically a theme will work with a company in an intrapreneurial setting. The company presents a problem framework within which the students then innovate as if they were a project group in the company.

We also have pure entrepreneurial themes. These themes could reflect one of TEK/SDU's core research areas, e.g. drones. The groups in such a theme work in a push-like entrepreneurial manner with the aim of qualifying an idea and pitch it to investors. Some entrepreneurial themes are not as such thematized. Here the students have freedom to develop and qualify any engineering relevant idea they might come up with, again with the ultimate goal of pitching it to a potential investor.

IV EXPERTS IN TEAMS: AN EXPERIENTIAL LEARNING METHOD

With the theoretical framework on experiential learning and the description of EiT at TEK/SDU fall 2016 in place we are now ready to identify and highlight the characteristics of EiT – or at least some of them - that makes it an inherent experiential-learning based course.

Characteristic 1: The ideation phase – phase 1 of the innovation process
As stated above our students are presented with very open problem frameworks and asked to develop and qualify an idea within that framework. They are given tools for ideation but after that they are left on their own to do the actual ideation. They are responsible for providing the information they need on e.g. markets and technology. Nobody but themselves drives the process.

Characteristic 2: The qualification phase– phase 2 of the innovation process
In this phase the students are also on their own in as much as they are the ones who have to identify in what ways it is relevant to qualify their idea. They are given tools - examples could be budgeting tools or Osterwalder's business model - which they can use in the qualification phase, but it is up to themselves to select and obtain all the data they need for the qualification.

The characteristics of both the ideation phase and the qualification phase distinguish both as Kolbian learning experiences rather than as part of a traditional course curriculum.

Characteristic 3: Reflection on the interdisciplinary team work
Throughout the course the students are asked to reflect on the interdisciplinary team work. Again they are given tools which can aid them in this but essentially the interdisciplinary-team-work-experience becomes a second Kolbian learning experience.

Characteristic 4: Reflection on own learning
As part of the examination the students are asked to prepare an individual learning report. In this report they reflect on their own learning. Both general engineering competences and specific core subject competences should be part of the reflection.

Characteristic 5: The role of the teacher
The teacher instructs the students in the use of various tools, e.g. collaboration- and ideation tools. The structured guidance in the use of such tools is very close to what would be expected in a normal curriculum based course, but the tools themselves are not part of the course curriculum – they serve only as suggested aids in the innovation – or group process. The teacher organizes the actual theme and coordinates with external partners but the teacher has little or no knowledge about the actual project framework and cannot serve as an expert on this. The main role of a teacher on EiT at TEK/SDU is that of a facilitator complying more or less with the facilitator characteristics mentioned above in section 2.

Characteristic 6: The learning outcomes

Albeit the course description is not explicit about EiT being experiential learning the learning outcomes are all very much what one would expect from such a course, i.e. somewhat intangible and vague and mentioning learning content only at a very general level with few if any particulars. In the course description we can identify the two processes of innovation and interdisciplinary collaboration as two "experiences" (cf. characteristics 1 and 2) the students have to analyse and reflect upon. In the end it is their ability to do exactly that, i.e. to analyse and reflect upon those two processes, which is evaluated at the examination.

IV CONCLUSIONS

The course Experts in Teams is characterized by being highly experiential in its organization. The students are presented with a problem framework within which they have to create a value proposition and qualify that proposition. This innovation process constitutes the learning experience in Kolb's terminology. Besides the innovation-experience the students also have to learn the importance and difficulty of interdisciplinary team work. This interdisciplinary-team-work-experience becomes a second Kolbian learning experience.

The students typically work in teams of 6. The team is on its own when it comes to identifying and obtaining the knowledge pertaining to innovation content itself. The teacher cannot in general be expected to be an expert within the project framework. The role of the teacher here becomes that of a facilitator.

The students are given tools to aid them in both learning experiences. These tools are presented to them as if they were part of a traditional course curriculum. However, the students are not as such evaluated in their theoretical understanding of these tools. If anything it is the reflection on the usefulness of the tools during their particular experience which is evaluated. Thus the course does not lose its status as experiential over this.

Besides the Kolbian learning experiences mentioned above other characteristics that define EiT as an experiential learning based course were identified and highlighted. The teachers clearly take on the role of a facilitator when they are working with the students on the innovation-process or guiding them on the reflections on the interdisciplinary team work. Finally it was also mentioned how the learning outcomes described in the course description closely fit the expected profile.

With this study I hope to have shed some light on EiT as it is taught at TEK/SDU in Odense. Clearly a course like EiT must always strive not only to adapt to the needs of the business world but also to incorporate the newest knowledge on innovation and interdisciplinary team work. This makes the course highly dynamic and not two semesters will be alike. Ultimately, however, the Kolbian learning experiences of EiT, i.e. the innovation-experience and the interdisciplinary-team-work-experience, will remain the two pillars on which the course is built – otherwise there would be no Experts in Teams.

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