AGENCY AND STRUCTURE IN ENGINEERING EDUCATION.
PERSPECTIVES ON EDUCATIONAL CHANGE IN THE LIGHT OF ANTHONY GIDDENS’ STRUCTURATION THEORY

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Abstract — Norwegian higher education has for a long time been strongly committed to individual strategies for development and change. A case study in a third-year basic engineering course at the Norwegian University of Science and Technology supports the idea that social change as a phenomenon should be paid more heed. After discussing this study, the paper turns to the kinds of challenges we face in higher education in general, and how these challenges can be met, theoretically and practically.

Anthony Giddens’ structuration theory is discussed in this context. It is not an educational theory, but has great potential for analysing situations of change. According to this theory it is the recursive social practices that help us to conceive both stability and change. Hence, structures in Giddens’ sense not only represent barriers, they enable change and development to take place as well.

Index Terms — Objectivism, structuration theory, subjectivism.

INTRODUCTION

Engineers are met by demands for better and more relevant competence. Consequently it is the institutions that educate them that have the responsibility to improve teaching and learning practices to promote generic skills and a more in-depth approach to learning. This paper is concerned with the conditions for change within engineering education. Empirical findings are drawn from my doctoral research at the Faculty of Marine Technology, the Norwegian University of Science and Technology (NTNU). Some of the central findings in my research will be analysed by concepts in Giddens’ Theory of Structuration as presented in New Rules of Sociological Method and elsewhere.

BACKGROUND

From 1995 to 1999 I was engaged in a development project at the Faculty of Marine Technology, NTNU. Lecturers at two different departments were invited to make use of data from course evaluations to improve teaching and learning in their courses. At that time student feedback forms were handed out by the university administration, but it was the lecturers that had the responsibility for making use of the different types of feedback provided by students.

In my research, I took a closer look at the ways in which students went about studying. The underlying idea was that improvements in the courses in some way should also be seen in the ways in which students went about studying, and in their learning results as seen in student papers at the end of semester exams. Based on simple time records by small groups of students in two different courses I was struck by the similarities of time distribution within both courses. The students spent less time studying than expected through the whole teaching semester except for the last week or so before the final exam. In so doing it was also apparent that the end of semester exam seemed to provide motivation for some students as an objective in itself.

These observations encouraged me to get a more reliable description of students’ approaches to learning within the whole group of about 100 students in a third-year basic marine engineering course. As students in their third year would have taken more than 15 courses altogether, this investigation would hopefully give a rough picture of the engineering learning culture in this faculty. This investigation also served as a basis for an action research group which was established in 1997, consisting of two professors, two research assistants and some students. This working group was met by the challenge of change from the very beginning, and this becomes the common thread through this paper.

COURSE DESCRIPTION

Marine Hydrodynamics and Ocean Environment was a compulsory basic course for third-year students at the Faculty of Marine Technology, NTNU. The main objectives for the lecturers were to review important parts of fluid mechanics and provide basic knowledge in marine hydrodynamics. Special emphasis was put on phenomena such as potential flow, linear waves, wave statistics and wave-induced forces on fixed and floating bodies. The most commonly used teaching methods were lectures and compulsory exercises. Grading was based on an exam of six hours. This exam was also part of the MSc programme in marine technology.

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APPROACHES TO LEARNING

Wave mechanics and wave modelling are topics that often cause serious learning problems for students. To obtain a satisfactory comprehension they need to get a grip of the physics of waves, and at the same time fully understand the mathematical methods that were applied to describe and model the waves. Marine Hydrodynamics and Ocean Environment, basic course, was known to be a demanding course. Therefore it was interesting to see how students went about learning this subject. What features characterised students’ ways of studying?

Empirical studies have confirmed that students vary in their approach to learning. In my investigation, students’ approaches were analysed phenomenographically, as illustrated by Ference Marton and others. Every lecturer has experienced that some students tend to give back exactly what they were given in lectures in their essays and reports. Other students are concentrating on developing their own understanding and a synthesis of what is written in the textbooks or given in the lectures. These two extreme intentions have been termed a surface approach and a deep approach to learning. The following examples illustrate this:

“I didn’t care about getting a deeper understanding of central ideas, but was satisfied with more superficial learning.”

“My intention is really to learn from this. I am not here with the ambition just to pass an exam.”

In the surface approach the student reduces what is to be learnt to the status of unconnected facts. Students experience the learning task as memorising and reproducing facts at a later date, e.g. in an exam. Students adopting a deep approach are more focused on making sense of what is to be learnt. This involves concepts and ideas, seeking integration between parts and wholes.

In addition to the surface and deep approaches, a strategic approach to learning has been identified. Students who are committed to this approach are extremely focused on passing exams. This seems to be more important than anything else, as the following example shows:

“I have got no deeper understanding of the subject. Preparations for the final exam were almost exclusively intended at getting a good grade, without thoughts of learning.”

In my investigation among students in a third-year engineering course the dominating categories were the surface and strategic approaches to learning. On the basis of this, measures were taken to change what was supposed to be important structuring properties of the learning environment. Our idea was that student behaviour, at least to some extent, could be seen as a response to central features or the framework of the students’ learning environment.

VISUAL MEDIA AND INNOVATIVE ASSESSMENT

The two professors in charge of the course were both discontent with the dominating features of superficial learning. On the basis of an action research model, steps were taken to promote the deep approach to learning. Extensive use of visual media was made to help students get a deeper understanding of the relationships between the physical phenomena and the corresponding mathematical descriptions in terms of symbols and equations.

At the beginning of the semester students were invited to a laboratory demonstration to observe the nature of different kinds of waves before getting any kind of mathematical description. After that they were offered ordinary lecturers on wave theory before the Maple computer program was introduced to show symbolic wave phenomena on a screen. Maple is capable of animating symbolic equations, and can be used to simulate the dynamics of waves based on a descriptive analytical equation.

The second important measure to improve student learning was a voluntary mid-semester take-home exam. It was introduced to help students focus on basic skills and knowledge to get a thorough knowledge of central aspects of the subject matter. There is repeated emphasis in the literature on assessment as the element of educational practice which most powerfully determines study behaviour. Therefore we were quite optimistic on behalf of the students. This would certainly allow them to focus more on learning, and less on just passing the final exam. To promote this attitude the take-home exam counted for 30% of the final grade.

During this process, which lasted from September to December 1997, data were gathered both from students and lecturers. A group of eleven students offered documentary material in terms of individual learning diaries, and they were interviewed after the exam to elaborate on how, and to what extent, different measures had been of any help to get a deeper understanding of the subject.

Unfortunately all the help that lecturers offered seemed to have just minor effects on those who were most likely to
need the extra support. Those who were most focused on deep learning to start with were the most positive, stating that both the use of visual media and of the innovative assessment had been of great help. This observation gave rise to central aspects of change. What determines study behaviour, and how can it be changed? This is an urgent question for those who are committed to making improvements in higher education.

**OBJECTIVISM VS. SUBJECTIVISM**

On a general level, objectivism and subjectivism denote the most influential positions in social theory. There are also lots of sub-categories within each, but this is not the place to elaborate more on this. The main point to keep in mind is the very different approaches to human agency. According to Durkhein there is an objective reality of structures determining human agency. In functionalism, system is primarily a descriptive term, the main burden of explanation being carried by function. “In structuralism … ‘structure’ appears in a more explanatory role, as linked to the notions of transformations”.

Phenomenology and hermeneutics are the most influential subjectivist positions in social theory. Human conduct is seen here as a result of individual preferences. This is seen in game theory which was developed at the end of the 1930s and has played an influential role in economic theory, political theory and decision theory. Subjectivist positions in social theory are strong concerning the production of meaning, but do not offer justice to the role of structures on human agency. An opposing position is that objectivistic positions do not offer a good theory of social practice as created by interpretations of human beings.

**THE STRUCTURATION THEORY**

Anthony Giddens’ contribution to social theory is to present a general ontological position. In “The Constitution of Society” Giddens states that central concepts in structuration theory should be conceived as “sensitising devices, nothing more”. The structuration theory may therefore be termed a generic theory. Contextual theories, however, need to be supplemented at empirical level. According to Giddens both kinds of theories are necessary, but the practical consequences of this appears to be somewhat unclear. Our challenge is to see whether Giddens’ structuration theory has anything to offer in the case of educational change.

Phenomenographic categories of learning as presented by Ference Marton et al. draw on the phenomenological tradition of thought. It may be termed a subjectivist position as any action depends on a selective interpretation of the world around us. The term approach denotes an intentionality from the actor. Giddens reminds us, however, that intentionality in action is a problematic field. He states that, according to Bourdieu concept of habitus, many actions may be seen as relatively unmotivated. “To be a human being is to be a purposive agent … But such terms as ‘purpose’, ‘intention’, ‘reason’ and ‘motive’ … have to be treated with caution”.

Acts may more realistically be seen as a “duree” “a continuous flow of conduct …” Here he uses the example of suicide: “Most acts do not have that characteristic”.

Anthony Giddens has directed a sustained effort at reconceptualising structure in recent social theory. He has been insisting since the mid-1970s that structures must be regarded as “dual”. By this he means that they are “both the medium and the outcome of the practices which constitute social systems”. Structures shape people’s practices, but at the same time it is the people’s practices that constitute and reproduce the practices. Human agency and structure therefore presuppose each other. Structures are enacted by what Giddens calls “knowledgeable” human agents. Accordingly, “structures must not be conceptualised as simply placing constraints on human agency, but as enabling”.

In structuration theory, agency and structure can be regarded as aspects of the same process. Social practices are recursive. Structures do not exist in time and space, but consist of a totality of “rules” and “resources”. “Rules generate – or are the medium of the production and reproduction of practices”.

“I shall treat resources as the ‘basis’ or ‘vehicles’ of power, comprising structures of domination, drawn upon by parties to interaction and reproduced through the duality of structure”. A structure has a virtual existence, but is a necessary medium for agency.

Structures enable recursive social practices to take place that always represent a flow of conduct, a “duree”. Such routine action is strongly saturated by being taken for granted. Giddens draws a line, however, between what he calls “practical consciousness” and “discourse”, that is, what people are able to talk about. Practical consciousness is

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11 Ibid.
19 Op. cit., p. 69
embodied in what actors “know how to do”- a kind of routine action. On the basis of this, we are faced with the challenge to see how human conduct can be changed, e.g. within a well-established learning environment in higher education.

**PERSPECTIVES ON CHANGE**

Giddens is strongly influenced by Freud, but develops his own theories of personality. An important feature here is what Giddens calls “the basic security system”. This helps the individual to reduce anxiety and inner tension. According to Giddens, establishing mechanisms to handle tension is of vital importance for every individual. “Where routine prevails, the rationalisation of conduct readily conjoins the basic security system of the actor to the conventions that exist are drawn upon in interaction as mutual knowledge”.18

Apart from secretional change , all other sources of change can be presumed to emanate from the external impact of influences that act to produce deroutinisation. “By ‘deroutinisation’ I refer to any influence that acts to counter the grip of the ‘taken-for-granted’ character of the day-to-day interaction.”19 To change a social practice new perspectives need to be communicated to shed light over what is not seen by the individual. This may be done by colleagues or by staff developers in a local teaching and learning resource centre.

It is most important to get the relevant focus of attention so as to prepare the ground for reflection and reorientation. Basic structuring elements of the learning environment need to be sorted out. It is also vital to establish theoretical approaches to change. Which elements are the most fundamental for the structuring of human interpretation and action? How can the selection and arrangement of structuring elements have an effect? To induce change presupposes that both teachers and students share a common understanding of the new patterns of behaviour. Typical examples of key structuring elements in an educational setting are the assessment system, the time allotted to every subject and, the marking criteria at the exam.

**TIME AND PERSEVERANCE**

Lasting social changes demand time, perseverance and consistence. If we look back few year, quality enhancement in Norwegian higher education was mainly based on offering courses for academics to become lecturers. Emphasis was put on how individual teachers could improve their teaching skills to become more professional in their role. From about 1990 there was a shift from the one-sided focus on teaching in a narrow sense to a more comprehensive understanding of framework influencing both teachers and learners.

In the decade from 1990 to 2000 there was a greater interest at government level for the quality of studies in Norway. In 1990, a committee was appointed by the Ministry of Education to take a closer look at aspects of quality in higher education institutions.20 Professor Gunnar Handal chaired the committee which presented its report in July 1990.

A major point in the report was that a significant improvement in the quality of higher education “has to happen as a dialectical interaction between changes in structure and changes in culture”.21 According to the committee, cultural change processes would be related to the attitude and competencies of institutions and individuals in their approaches to change.

In 1999, a survey study was conducted to assess the status of development in Norwegian higher education.22 The major question to be answered was whether the recommendations from the quality report from 1990 had had any effect on the institutions’ educational development. One of the findings here was that at many institutions there was a lack of a comprehensive vision on development. Consequently, an important synergy effect was lost. Measures also lost some of their potential impact because the underlying philosophy was neither fully understood nor accepted by the actors.

**CONCLUSIONS**

According to my view, Anthony Giddens’ structuration theory represents a most valuable perspective on educational development and change. It is neither the structure, nor the individual and contextual interpretations that give the key to understanding social change. It is the nature of recursive social practices that help us conceive both stability and change. Hence, structures in Giddens’ sense not only represent barriers, they enable changes to take place as well. To succeed in implementing change there is a need to make certain options more likely than others, and there is a need to put pressure on commonly understood and accepted directions.

According to the structuration theory there should be no embarrassment about the results from our development efforts described in the first half of this paper. In the third-year course students had established a learning style, a “duee” that was not easily changed by our measures. From Giddens’ point of view each of our three phenomenographic categories can be seen as a well-established flow of conduct.

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20 The Committee for Quality in Higher Education.
Students did not really believe in the professors’ intentions that there would be a stronger demand for understanding at the exam. Students who had established a deep approach to learning benefited greatly from the new learning opportunities, whereas those with superficial and strategic approaches did not benefit at all.

Educational development in Norwegian higher education has for a long time been strongly committed to individual strategies of change. Giddens’ contribution makes it likely that educational change as a phenomenon should be afforded more time and energy. Therefore it can be worthwhile to consider the kinds of challenges we face in higher education more thoroughly, and find out how these challenges can be met in the future, both in theoretical and practical terms.