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ALLOWING PLAYFULNESS - EXAMINING INNOVATIVENESS

Anders BERGLUND[1] and Monica LINDH KARLSSON[2]
[1] Dept of Machine Design, Royal Institute of Technology (KTH), Stockholm, Sweden
[2] Umea Institute of Design (UID), Umea University, Umea, Sweden

ABSTRACT
A child's playfulness and ability to fantasize are also key creative mechanisms in adulthood. Allowing low formal control functions and high self determination is valuable for intrinsic motivation, triggering new ideas, curiosity, experimentation and the desire to impact and change traditional practices – creating innovativeness. This paper sets out to do three things: provide a literature review of the different aspects and angles of knowledge- and competence learning, and the area of creative techniques and an innovative team process; offer experiences and learning from the unique case studies used; and thirdly, to present the concept of Innovopoly - a new tool to better achieve creative learning and examination in higher education through both the innovative working process and the creative process. These elements together give us the ability to discuss how higher education could best implement courses and methods in order to prepare our students for the future.

Keywords: Higher education, creativity, case studies, design education, design project, engineering project, Innovopoly

1 INTRODUCTION

Based on strong industry concerns, skilled engineers now face greater involvement in understanding and promoting individual innovativeness. Since design problems are ill-defined, ill-structured or wicked-problems [1], the following analysis and the problem-finding design process often culminates in a reasonable solution and not a correct answer, and this will in turn require a skill to define, re-define and change the "problem-as-given" [2]. However, there is scant evidence that higher engineering education programs are promoting innovation capability as a skill that can be developed. In this sense, innovation capability involves a series of factors where the ability to work creatively is considered one of the central enablers to innovativeness [3].
Creativity is important in the ability both to develop new solutions to a defined problem and to identify the actual problem. Understanding innovativeness involves creating awareness in how distinct development phases correspond to individuals - e.g. professionals educated with different processes, using different methods, and working in different organizations – in order to more effectively build skills to leverage and apply the brainpower available to them [4].
From an innovative perspective, a team requires both individual and mutual accountability, commitment to a common purpose, shared leadership and autonomy. These can influence and encourage behaviour because they increase individual and team-level performance [5]. Working in a group can open up a broader set of perspectives and refinements of ideas for each individual.
Work group creativity can also be enhanced when a work environment provides rich knowledge stimuli, sufficient resources and a challenging workload [6]. But the difference between perspectives, methods and processes can also inhibit the high creative performance if the interaction and integration between members in a group fails. The divergent process needs a social interaction between different knowledge and processes to result in innovative output. From a gender perspective, there is a lack of knowledge in how gender and team work affect each other [7]. Will it affect the communication between team members in such a way that the social interaction became difficult?
It is our experience that engineering education trains too few of these capabilities. All individuals have the gift of creative thinking, yet far from all anticipate this ability and mostly surface this hidden resource [7]. To better grasp and utilize this capability, personal disbeliefs and mental obstacles have

to be surpassed. In order to successfully interpret methods, frequent use and training is vital not only to get familiar with each method but also to develop the ability of divergent and creative thinking, practice design-thinking and further hone the creative output after a creative session. Based on our analysis and experience we propose an education model that allows students to take more responsibility for their own learning and examination, and engage in the learning situation in a more creative way. We also highlight further areas for course-development and collaboration.

2 INNOVATIVENESS, CREATIVITY AND THE LEARNING SITUATION

With *Innovativeness* we refer to individuals and their micro level activities, where outcome is perceived from a variety of cognitive concerns (e.g. willingness to act) [9] [10]. Most creativity methods are used to promote ideas from an inner-directed perspective, effectively meaning that students are obliged to use current available knowledge to interpret and use a knowledge-base established by pre-existing cases. Creativity is inhibited in all individuals, thus unleashing innovation capability relies on focusing on new thinking patterns like using metaphors and combinations [11]. Following the insight that creativity engenders improvement in innovation outcomes [10][12], links emerge between experimental learning and reflection [13], and intrinsic motivation and internal drivers (e.g. personality, creative thinking, communication skills) [9] [12] [14]. Through acknowledging the unique ability that resides within each individual, different people will approach a problem differently. Creative thinking, by encouraging openness to a variety of approaches, makes team members share their thinking and ideas more freely. Once this openness is achieved, the team's innovative capability begins to emerge, taking advantage of the different thinking styles, rather than experiencing them as conflicting forces [15]. The social architecture and social structure are connected to a team's level of performance. Commitment to one another is a key characteristic of a high-performance team [5]. Other factors that could be mentioned are mutual accountability and interchangeable skills.

The importance of newness and creative thinking is fundamental in producing improved products and processes. It is the very pillar that allows technology to leap forward and for people to live a more qualitative life, aided by technological incentives. However, if business is to continue delivering innovation, more attention should be paid to what actually drives these new models. One suitable way of doing this is to monitor what takes place within project courses in a handful of cases in higher engineering education. Idea generation is essential in engineering design projects, where various methods exist to promote divergence and systematic thinking approaches to an area otherwise free of constraints and regulations [16].

In academia there is a tradition and a pedagogical structure to teach knowledge and theory. Contemporary demands in educating students for their professional life include competence to perform and experience of generic knowledge. Studies today require students to be active in the learning process where recurring issues and reflections on existing knowledge occur. Problem-based learning in conjunction with others can lead to students experiencing knowledge at a greater depth, as well as complementary learning from the conversations involved [17]. A learning process that allows students to be the active party, more or less defining their own objectives and methodology, gives the student more control over the learning situation. The experience is expected, given the so-called network or the cognitive structure evocative of a particular situation and conduct. Our Experience Learning model involves both the building and developing of knowledge, and the rejection of prior knowledge – thus teaching an individual how to balance information - new with old - in order to create and maintain their own holistic knowledge base. Knowledge construction in an overall project-based course is guided by performance and behaviour but also by thinking and reflection on methodology and process, choices and decisions, and of course results. There are four different phases in experience learning [18] - awareness, action, thought and reflection -and the education process requires a balance of all four in order to construct learning. - If any of these factors is too weak, the learning process becomes a negative one. Good quality in learning is related to how these four elements are processed [19]. A learning process in higher education can take three paths:

(a) *Assimilation*: acceptance of new knowledge and integration with earlier knowledge and experience, with confirmation or rejection of existing knowledge and experience; (b) *Accommodation*: struggling and questioning, followed thereafter by acceptance of the new knowledge; or (c) *Homeostasis*: avoidance of new and expanded knowledge and so-called latent "chafe" [19]. The learning cycle can then be described as a hermeneutic reflective process where new insights through reflection create new

perspectives and knowledge in order for the circle to continue. Learning in this manner is clearly not easy, and students need to be both motivated and in control of their own learning.

3 THE CASE STUDIES OF CREATIVE TECHNIQUES

Engineering and design education trains students in practical competences to work with creative techniques and processes. The KTH graduate course Integrated Product Development (IPD) is a full year academic project course of 30 ECTS. The objective is to learn about the process of creating, organizing, planning and executing an innovative output by the end of the course. The important thing with IPD is for students to learn and interpret how the process of realizing ideas is put into practice. The IPD projects run in larger teams of approximately 14-15 students, and, depending on class size, in two or three parallel groups. All participating students receive a differentiated grade when the course ends, where the project weighs 60% of the total grade. Rooted in Argyris [19], double loop learning thoughts, reflective learning is fundamental to the course. This takes form in activities such as lessons learned, log books and wish/like exercises. Since product development practices cover a stepwise inclination towards functional prototypes, the IPD process involves activities such as QFD, concept evaluation, and the organization of a creative environment. In the first quarter, a number of creative techniques are introduced. These methods are worked with and put together as online support documentation following a student-to-student pedagogical presentation, where students put together the lecture based on their respective supporting technique summaries. Use of the joint web portal enables easy access for all participants as the project proceeds.

The quantity of ideas created works as a creative platform where new ideas are triggered as an outcome of interpretation of existing ones, thus as a driver to create new ideas. Furthermore, visualization efforts (e.g. sketching) have a creative element of their own, enabling visual stimuli for the back-story and re-defining of the problem [21]as the ideas are ‘wallpapered’ in the project room. The strategy behind this is to establish a possible synergy, where a large number of ideas evoke new ideas by means of association. In the end, all creative output results in some sort of a convergence. In this case, the best ideas are selected by matching against their ability to solve the initial problem from the industrial partner’s criterions. Overall, the ultimate challenge resides in transferring the early 2D shapes to something tangible and after two semesters functional prototype.

At the Umeå Institute of Design, the overall pedagogical strategy, embodied in the Industrial Design Programme, is to combine shorter courses with knowledge building objectives with longer blocks of applied projects with external partners. Only Pass or Fail are used as grade ratings and credits are given with 4,5 ECTS. The courses can be divided into two categories of educational direction: ‘knowledge’ and ‘applied competence’, each needing different types of didactics and pedagogical support. The course in Creative Techniques recurs on a loop for three years and practice as a competence to apply in projects every semester. The first Creative Techniques course objectives are to identify, apply and distinguish techniques. The second course objectives are to identify, apply and distinguish different methods and their characteristics. Students are divided into small groups of 6-7 students and they each take full responsibility for the learning situation and the pedagogical method, “Problem Based Learning” (PBL). They work with a contemporary problem-based case and are expected to practice different creative techniques during their knowledge construction, with the teacher acting as a tutor. Visualization with sketching and low-tech models is used in the creative process, resulting in both a visual concept and a written reflection. The third set of course objectives are to distinguish, critically examine, compare and reflect upon the application of a creative process in different domains. All three courses are prerequisites for longer applied project courses given every semester. Generally all group presented reasonable and innovative concepts at the end of the course. In varying degrees the creative process was delayed or stalled because of group dynamic issues. That stressed students in various degrees to feel performance anxiety and fear to fail the task. Since it was a short knowledge input course students reasoned in two ways: a) Some students let the more convinced and motivated student take control over the process and stress a result or, b) some groups chose to do a stoppage for a fun experience together in the evening. A reflection from the teachers´ perspective was that the working phase with the creative techniques did not involve all students’ differences due to difficulties in the group dynamics and there was a lost period of motivation and risk-taking in almost all groups. Once the process lost speed the accountability to the group task and divergent thinking at an individual level achieved a low level. In the evaluation of the course students mentioned temporary lack of motivation when they lost the control and felt they were not involved in the process.

One mutual aspect for both cases is the idea to apply creative techniques and not just work in theory.

4 THE GAME CONCEPT

Examination of individuals working together in groups or teams is always difficult. Thus, the importance of a systematic approach such as *Constructive alignment* is fundamental [13]. One key to achieve a greater awareness and reflective learning is through those activities that align the learning objectives with the examination requirements. Therefore our concept development phase started with workshops involving students with prerequisites in innovative processes on a basic level. We used brainstorming with discussions, reflection and prototyping as methods to understand how students interpret examination of teamwork in an innovative process. We want a learning process that combines the student being an active subject of learning with a knowledge building and experience learning approach. This should be done with a high level of awareness, actions, thoughts and reflection and a creative team process where students are mutually accountable, share leadership committed to a common purpose and a high level of autonomy [5]. Working towards promoting individual innovation capabilities in higher education involves embracing openness, not only to what possibly might go into the curricula but also to the examination procedure. Our workshops sessions opened up some difficult areas to solve. Our experience after our workshops with the students was that we must resolve the differences that exist in a group of students. One example is that of an artistic education is a selection of competence and skills through work samples and interviews while in engineering education is a selection by competence through scores. Student groups are represented in varying degrees to students who have talents and abilities to be stimulated by working with creative and innovative processes. Problems with group dynamics and ways to solve the task may appear which in turn affects divergence and communication within the team. It can affect the learning process and makes demands on how the individual examination shall be conducted. The students felt it was important to feel great confidence that the examination made visible their individual abilities clearly.

To make interaction mode, enthusiasm and deep learning intercept, we present the idea of allowing playfulness when examining innovativeness. The idea is to build on one of the most familiar board games that have ever existed…Monopoly. Now, instead of just playing it together with friends the idea is to put together a game plan under the label *Innovopoly* where students themselves put together and play the game as preparation and a part of their examination. The game plan is divided into four acts: firstly, students assemble the game they are to play. They start with mutual problem identification based on given course materials and collecting research material specifically in visual format and with a holistic approach to the problem. Secondly, they define a mutual process and a time plan. Thirdly they start to play the game with a time perspective from one day to one week. Fourthly they orally present the process and results. The outline of the game plan should carry the logic from the innovation process – ideation, concept, prototyping, testing and commercialization similar to the value increase as can be back traced to the original game form. The knowledge construction is supported in their performance, behaviour, thinking and reflections during all four phases.

A key-factor for Innovopoly is student control and active participation in the learning situation. Together with other students they practice and build/construct their own learning path. This also stimulates the creative team process that strengthens the innovative performance and creates autonomy in the team - through intrinsic factors such as motivation and the understanding of skills variation - and supports the learning process of competences. What sort of competence do the students gain from this? Working together in a group or a team involves group dynamic skills. Every time a new group session starts there are unknown situations and new challenges ahead for all involved. From the educational perspective, as the process is not static, competences have to be dynamic, built on individual skills and, experience and reflection, enabling deeper learning through a reflective process. With a reflection-on-action, looking back over our experiences in a particular situation there is a sort of “dialogue” of thinking that can contribute to a more developed understanding and generate insights and thinkable new solutions. [21]. Playing Innovopoly with all the inbuilt possibilities and opportunities also opens up for reflection-in-action, as it is not a static game. On the contrary, the whole idea with the game is that it requires the team to come up with new solutions both in terms of divergent thinking and at a process level. This is also one of the cornerstones of why the game includes visualization and prototyping. Through visualizations and prototypes the “reflective conversation with the situation” can be possible with the back talk from the material [21], opening up for ideation and problem finding, divergent thinking and creating a common platform for the team to

discuss and experiment with. Based on that, we suggest that reflection-on-action as well as meta reflection should be used as a method for examination.

To what extent could the progression and completion of the learning outcomes be measured? What pedagogical methods can be used for both learning and examination? We suggest that performing a process as a team combined with deriving a solution to a problem connected with reflection-on-action text and a meta reflection should be a qualitative way of identifying both knowledge and competences in a dynamic process. In essence, we want the students to write a reflection-on-action individually after every phase as a part examination but also a meta reflection after the whole game process. We suggest that the learning outcomes should be defined as the ability to reflect and critically review the working and the team process, but also to generate various ways for future work. Based on given guidelines that align with topic specific learning objectives, the course is ideally of a comprehensive nature, running 100% over a short period of a couple of weeks, making 3 ECTS or equivalent number of credits. The target group should be first or second year students, but the concept could very well be redesigned to match requirement of more senior students. The ideal number of players would be 2-6, as in the traditional version, but this can of course be changed if playing in teams.

Innovopoly does comprise some alterations to pre-existing elements: video clips that the students themselves have been responsible for are used instead of the decks of cards (e.g. *Chance* and *General*). Students engage in interactive exercises ranging from idea generation exercises, rapid prototyping and patent investigations to idea/road show/sales pitch presentations. It is important that they get sufficient resources and that powerful knowledge stimuli are created to facilitate cross fertilization and a broader set of perspectives. An additional focus is the way team members interact with each other and with the material, using reflection-in-action to frame problems and create solutions. If input material is too small, additional material can be supplied.

Innovopoly involves a class working in groups playing games in parallel and competing with one another. Still, the set up could be used for individual examination, covering both individual ability and team performance. In both cases the subsequent reflection-on-action and a meta reflection will be an important tool to examine team process, learning process and result vs. problem identification. For high performance results, incubation and individual idea generation sessions are suggested after group sessions to allow for individual reflection [22], to avoid limiting the opportunities for expression of ideas and activating related associations.

Creativity is in general defined as the first step and development of a new idea [6], and an innovation as the deliberate development and application of ideas into a reality [23]. Innovopoly wants to examine the innovative process within a team but also at an individual level; moreover the examination needs to identify the level of the outcome from that process. The game examines divergent thinking, for example, using four categories: Flexibility, Originality, Elaboration and Fluency [24]. Performance derived group level innovation should be evaluated on the basis of the actual implementation of the creative idea or product by the group.

5 CONCLUSION

This paper presents a methodology of how to examine innovation in higher engineering and design education. Inspired from game plans, the methodology puts forward the integration of course activities, learning objectives and course requirements in a completely new format – an evolving game platform that students themselves proactively put together and provide peer evaluation. There are three fundamental concerns in the outline of the new game plan examination format. Innovopoly is designed to better enable: 1) high student involvement, 2) deep level learning, and 3) fun and excitement. Student empowerment is the underlying element that impacts the quality of the course design. Creative thinking and student innovativeness have a dualistic relationship, and are thus best perceived from a two-fold perspective. Firstly, innovativeness encompasses a greater domain than merely individuals creative incentives (e.g. group dynamics, project management, technical know-how, and communication skills). Secondly, due to the nature of the course (i.e. extensiveness) isolated pieces like idea generation would only portray a skewed and unfair picture of an individual's innovativeness, especially when creativity can also be seen as a process at a social level and not a result of many individuals trying to be creative on a personal level. [25]. However, without a rigid understanding of how to trigger innovative thinking, both lecturers and students are incapable of fully testing and experiencing possible solutions. How to define the input to a creative session, evaluate in a bold way with a holistic approach and implement the result in the overall developing process still has to be

formulated, taught and examined. We want to put emphasis on the idea that ill-structured problems lead to an active problem-finding process, divergent thinking and less at preferred solution concepts. With a precise defined problem as an input in a creative session, designers generate more concept solutions and have less problem framing. [2].

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