Creativity in Project Work—Students' Perceptions and Barriers*

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In this paper, we will present case study results from a cross-disciplinary education named Medialogy, which is taught in the Technical and Science Faculty at Aalborg University. The aim of Medialogy is to facilitate creativity within technical solutions, and thus the intention of this paper is to answer the following: What is the Medialogy students' perception of creativity and in which part of the process of problem solving do they view themselves as being creative? In Medialogy, the education explicitly focuses on the little-c creativity and communicates the everyday life and evolutionary creativity to the students. The Medialogy students also perceive creativity as the little-c creativity that contains something interpersonal and intrapersonal, and by means of which products can be developed. They do not regard creativity as focusing on interaction and social context. They perceive that they are creative during all stages in the project work. However, it is also significant that the Medialogy students believe that they are more creative in the beginning of their projects and during the design and implementation stages, whereas the analysis is a less creative part. In general, the Medialogy students request further tools for creativity as well as more support for the creative process from the supervisors.

Keywords: creativity; problem based learning; project work; engineering education; perception

1. Introduction

Creativity is enjoying a global renaissance of interest, not only in academic disciplines such as sociology, psychology and education, but also in applied sectors such as design, business, politics and technology. Students and workers are expected to apply what they learn in new and creative ways, so as to ensure continued productivity, economic growth and social welfare [1, 2]. This is also the reason why educational systems have started focusing and developing students' creative abilities and skills. This paper is part of a larger research project that explores creativity within a university context, and aims to answer the fundamental question: How do we promote creativity in students' learning process so they obtain skills in creative problem solving? We will present some research results from a cross-disciplinary course named Medialogy, which is taught in the Technical and Science Faculty at Aalborg University. Medialogy aims to facilitate creativity within technological solutions in an everyday life context. Many studies deal with different factors connected to creativity, and this paper posits this question: What is the Medialogy students' perception of creativity, and in which part of the process of problem solving do they view themselves as being creative?

2. What is creativity?

The term creativity is used with different meanings across different disciplines, fields and contexts, and more than a hundred different definitions can be found in the literature [11]. Feldhusen and Goh [37] stated that any definition of creativity must include related cognitive activities such as decision making, critical thinking, and metacognition [37]. A similar perspective is found in the research focus within identification and measurement of creative thinking skills, where professor of psychology Michael Mumford suggests this definition: 'creativity involves the production of novel, useful products' [12]. This is also similar to what Boden calls historical creativity [13]. As a starting point, we agree with Feldhusen and Goh, Mumford and Boden. Creativity must be a production of something novel. The problem, nevertheless, is how also to evaluate 'useful products'. From our perspective, the definition of creativity should be targeted in both a macro level (taking culture, organizational structures, environment, products and processes into account)

and micro level (taking the individual person into account). According to Ross Mooney [39], one of the researchers who pioneered independent work in creativity, each person has his own explicit or implicit definition or subdefinition of creativity [39]. Mooney described four different approaches to the problem of creativity: environment, product, process and person [39]. Amabile has also documented that creativity in each individual has three components: expertise, creative-thinking skills and motivation [30]. Florida [15], furthermore, argues that every human being is creative, and by this he means 'capacity of innovation, a by-product of the innate human capability to evolve and adapt' [15]. We can also see creativity as a set of skills [16]. The logic of creativity is, according to De Bono, based on self-organising information systems that can be called patterning systems. From this pragmatic approach the logic of creativity is then the logic of these systems, and how individuals use a specific behaviour to think in a particular way, which he calls lateral thinking [16]. Lateral thinking is a basic assumption for De Bono's development of a logic learning process for individuals to be aware of when developing creativity [16].

In our understanding of creativity we include the social context, the product, the process and the individual person. We call something creative if an individual or group produces a novel and useful product within a social context. We also agree that creativity is correlated with motivation [18, 19, 20], because significant creative work requires 'sustained focus, hard work, well organized knowledge, persistence in the face of failure, and a coherent presentation of the work' [21].

3. Creativity in educational context

The relationship between creativity and learning has been widely recognized and researched [7, 15, 19, 25, 20, 36]. Learning and creativity in technology based education have received an increasing amount of attention in other disciplines of education as well as in research. There have been many studies on the promotion of creativity in technology education [22–24, 26]. For instance, Professor Moshe Barak [26] describes the theory of self-regulatory learning as self-regulatory behaviour highly correlated with an individual's motivation to handle challenging assignments, and with the pupils' internal satisfaction from being engaged in a task that contributes more to creativity. To be more specific, Barak concludes that, to foster students' self-regulatory behaviour, it is necessary to engage them in open-ended assignments in an informal context [26]. It is also important to encourage students to think iteratively and to be ready to

reconsider or revise earlier assumptions about the nature of the problem they are addressing or the required solution [26]. Several studies have also focused on both teachers and students perception of creativity in very different contexts [34, 35, 36, 38]. Fleith [35] investigated teachers and students perception about characteristics which either stimulated or inhibited the development of creativity in a classroom environment. The findings showed that an environment which inhibits creativity, ideas are ignored, teachers are controlling, and excessive structure existed [35]. Jaba et al. [34] presented the results of a sample survey regarding perception and stimuli on 158 students from three institutions of higher education in Romania. The results showed that the main factors that influence students' creativity are education, academic environment and human potential [34]. Jaba et al. [34] also found that the students showed their creativity both individually and in groups. The challenge for students working with pedagogical approach connected to Problem Based Learning (PBL) [32] and project group work is how to establish the creative processes. Some studies point out that a creative process is very individual and will often suffer in a group process [16], but we also argue that creative processes in groups can be very effective when given the right support as facilitation, awareness of behaviours, the use of creative tools and surroundings, as well as the use of special pedagogical methods to enhance the creative processes amongst students [27].

4. Methods

This research is based on the methodology of a case study [33]. We established the ideal case study approach because we needed a holistic and in-depth investigation with use of multiple sources of data [4, 5]. The case study is Medialogy, whose goal is 'to develop problem solvers in a digital media age independent of tasks'. This goal is achieved by merging creativity, arts and technology through the development and cross-combination of areas and topics within the field of engineering technologies, computer science, psychology, sociology and arts. The slogan used for Medialogy is 'Where creativity meets technology'. Therefore, in both external and internal communication, it explicitly targets cross-combination, creativity and technology. Medialogy has a bachelor's and master's programme. The PBL approach as well as group project work is essential for Medialogy, as the assumption is that this pedagogical method strengthens interdisciplinary education.

This research employed a method design based on both qualitative and quantitative methods. The
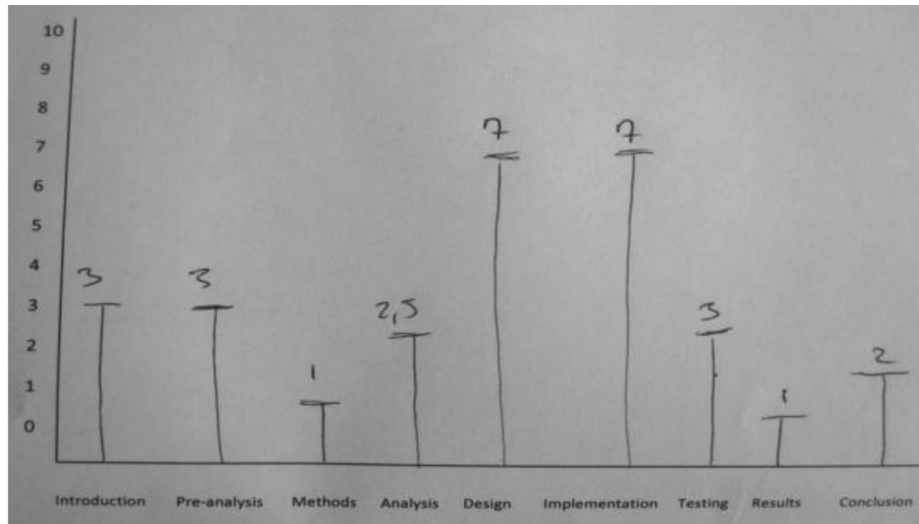
Fig. 1. An example from a student who filled in a VAS rating his/her creativity throughout the stages of the project work.

quantitative part is based on questionnaires in paper form. The quantitative data was collected in November 2010, and it took about two weeks to collect the data. In total, 144 students from all semesters participated in the study. The questionnaire was divided into four sections. Section one requested age and which semester they were attending. Section two requested a single statement from students concerning their creativity and the degree to which they felt creative. We used 5-point Likert type items [6]: 'To a very high degree'; 'To a high degree'; 'Somewhat in between'; 'To a low degree'; 'To a very low degree'. Section three contained questions related to which part of the project they were creative. Section four was an open-ended question: 'If you have further comments, we would be more than happy to read them. You can write your comments here'. The questionnaire included a page for supplementary comments.

The qualitative data was collected in March 2011 from focus group interviews. We used purposeful sampling [14], meaning that the population was Medialogy students, but we wanted to recruit two collaborative teams from semester 2, 4, 6, 8 and 10. This meant that we had 10 focus group interviews with 30 students. By recruiting from five different semesters, the guiding principle was to include students who represented a variety of perspectives. The focus group interviews took place in either the students' own group room or in a meeting room. The interviews took between 1 hour and $1\frac{1}{2}$ hours.

We used a semi-structured interview guide [14] with four different themes. Theme 1 was questions on why the students had chosen Medialogy. Theme 2 was questions on creativity in Medialogy. As a starting point, we used a VAS (Visual Analogue Scale), where students in the focus group individually specified their level of creativity in Medialogy along a continuous line between two end-points, going from 0 (Not at all creative) to 10 (extremely creative). After each student recorded his or her subjective number, we asked all in the focus groups why they chose the specific number and followed up with questions on creativity in Medialogy generally.

Theme 3 was questions on definitions of creativity, asking questions like: 'If you were to express in your own words what creativity is, what would you say?' Theme 4 was about creativity during the collaborative project work. We also started with a VAS, so the students could rate from 0–10 (from 0—not creative at all—to 10—maximum creative) how creative they perceived their project work. We followed up with some additional questions based on their responses. Then, we made the students draw where in the process of the project work they were most creative, with indication of a specific number for the different stages of the project.

In order to analyse the interview data, we used meaning condensation [17]. We examined the extensive interview texts by looking for natural meaning units and explicating some main themes. These themes were, thereafter, subject to more extensive interpretations and theoretical analyses following a phenomenological approach [17].

5. Findings

5.1 Creativity at medialogy

The concept of creativity is often associated with the term innovation. However, innovation is more accurately what follows the creative process—

'something which stems from the application of new, creative ideas into concrete and specific contexts and which is explicitly recognized as valuable by the society' [1]. Creativity in an educational context is often referred to as 'little-c creativity'—everyday, evolutionary creativity [1]—as opposed to the 'Big-C creativity'—revolutionary creativity. We agree that this distinction between little-c and Big-C might be too simplistic [40], but in Medialogy, the education explicitly focuses on the little-c creativity, and communicates everyday life and evolutionary creativity to the students. Although Medialogy mention and apply to Big-C creativity, Medialogy aim at everyday, little-c creativity. This can be seen in the project reports and problem statements, which focuses on everyday problem solving, with special focus on the social context (described in the pre analysis of the project reports). In the prospectus and on the Medialogy webpage it is stated: 'Medialogy offers an exciting combination of courses that enable you to communicate and collaborate across the varied disciplines needed for creating and performing research in multimedia content and technologies. Medialogy is where creativity meets technology, so this education also contributes to finding new technological solutions which might help people in their everyday life'.

Medialogy enables students to develop domain-relevant skills, creativity-relevant skills and task motivation [30], in problem solving in a digital media age independent of tasks. The significance of cognitive science in defining creativity is its almost univocal assumption that skills as such do not suffice when it comes to acting creatively. The creative process also depends on inner motivation, domain specific knowledge and supportive surroundings, amongst other things. From this perspective researchers [2, 7–9] have recognised that creative processes are grounded mainly on cognitive capacities, meta-cognitive abilities and affective involvement in the tasks to be performed. Understanding, skills and self-reflection are necessary for being or becoming creative, although these are not the sole determining factors. Sternberg [8] also argues that there is not one creativity but a number of creativities, which further emphasise its complex character.

From the questionnaire the students stated how they perceived the term creativity.

Thirty-nine percent of the students viewed creativity as the ability to create something new and 30 percent as the challenging of existing ideas in different ways. This perception is similar to the findings in Jaba et al. [34] and Amabiles' approach to creativity [2, 30], which is taking existing problems and coming up with solutions. However, the Medialogy students also focus on uniqueness as having the ability to create something new, which is identical with the definition of creativity given by Hasse [31]. In this sense, the students perceive creativity as something interpersonal and intrapersonal, by means of which products can be developed. None of the students regard creativity as 'communicating with others', whilst only 4 percent define it as 'continuing to ask questions', which indicates that for them the focus of creativity is not interaction and social context. Therefore, they associate creativity with the little-c creativity, which is in line with the education's explicit focus on new technological solutions which might help people in their everyday lives.

The evidence from the focus group interviews is that students have very different perceptions of creativity; some also describe it as fuzzy and soft construct. This is very similar to what Mooney stated in this theory of creativity [39]. On the other hand, they also have a concrete and operational definition and very often mention some of their own prototypes and products from previous projects in Medialogy.
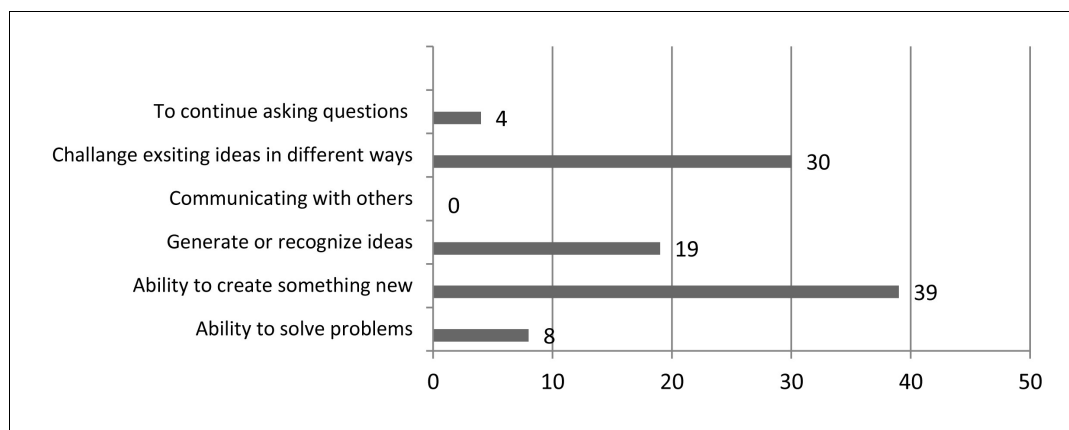

Fig. 2. Percent medialogy students' perceptions of creativity ('I think creativity is . . .' n=144).

It is a funny thing with this creativity concept, because it is difficult to be 100 percent creative if you already have the themes you have to be creative in. The creativity comes from the problem you have. For having really original ideas you need other inputs and influence, otherwise you just reproduce what you already know. . . For example we made this project on our 8th Semester having some inputs from a guy in the industry (Focus group interview: Male, 10th Semester student).

I would say creativity is expressing yourself (Focus Group: Male, 4th Semester student).

Creativity is the ability to generate ideas (Focus Group: Male, 4th Semester student).

It is like a method, so it is the process of creating things which is creativity (Focus group: Male, 8th Semester student).

It's solving problems in new and better ways (Focus group: Male, 2nd Semester student).

Medialogy at Aalborg University use the principles of PBL [3, 10, 32]. Every semester 15 ECTS is dedicated project work in collaborative teams of 2–7 students. From a philosophical and sociological standpoint, the PBL method at Aalborg University also implies that the projects are unique and address a real life problem. When the problems are unique, so too are the solutions. Therefore, creativity is a premise for problem based learning. The project is defined as a complex effort that necessitates a problem analysis 'that must be planned and managed, because of desired changes that are to be carried out in people's surroundings, organization, knowledge, and attitude to life; it involves a new complex task or problem; it extends beyond traditional organizations and knowledge; it must be completed at a point in time determined in advance' [10].

Each student group has a supervisor, who advises and facilitates the project work. During each semester in Medialogy, the study-plan requires the students to build an artifact or implement an application that can serve as a medium for a scientific test to either prove or disprove the claim that their new approach can solve the problem. The normal project structure in Medialogy has these stages:

1. Introduction: Motivation, background, describe the need for this unsolved problem, initial problem statement.
2. Pre-Analysis: Delimitations, previous work, state of the art (both products as well as research), approach, target group, might use qualitative, quantitative methods, field studies. At the end of the pre-analysis, come up with a final problem statement.
3. Methods: How they have solved the final problem statement. Qualitative, quantitative methods, field study, diary studies, lab experiments. How many are recruited? How are they recruited?
4. Analysis: Theory, specifications, standards, in-depth investigation of the subject matter.
5. Design.
6. Implementation: Implementing the technical aspects in the project.
7. Testing.
8. Results/Findings.
9. Future perspectives/ Discussion.
10. Conclusion.
11. References.
12. Appendix.

From the focus group interviews, it is interesting to note that several students explicitly mention the PBL principles as a barrier for their creativity:

The PBL has some limitations, because we need to find a problem, and not just find something cool (Focus group: Male, 2nd semester student).

Dividing creativity into some stages in the report structure does not make any sense. It is like we squeeze creativity in the project . . . it is because of the Aalborg University creativity (Focus group: Female, 10th Semester student).

The creativity dies and disappears because of this PBL. When we start a project we have lots of ideas, but then we have to analyse it first. It is rather depressing (Focus group: Male, 2nd Semester student).

It is good you have the freedom to choose the project you want to work with, but it does not mean that it also stimulates your creativity (Focus group: female 10th Semester student).

It is of interest that the PBL approach should enable students to be creative during the whole project process. They have a great degree of freedom to choose the problem areas they want to work within their projects, but of course the study regulations set the framework for choices and also time limits. Thus, the freedom to choose and analyze a problem is apparently not supportive of the students' experience of creative possibilities. They might need more explicit support with creative processes and how they can fit into the different phases of their projects. As stated by De Bono, students should learn the logic of creativity [16].

Another aspect is that the project structure has become too fixed by the teachers' attempt to unify and control the learning outcome. Still, there should be possibilities for students to experience creativity.

5.2 Creativity during the project work

It appears from the questionnaire that the Medialogy students perceive they are creative during all stages in the project work. However, some stages are more creative than others. For 93 percent of the students, they work creatively during the design stage, whereas 29 percent work creatively during the analysis.
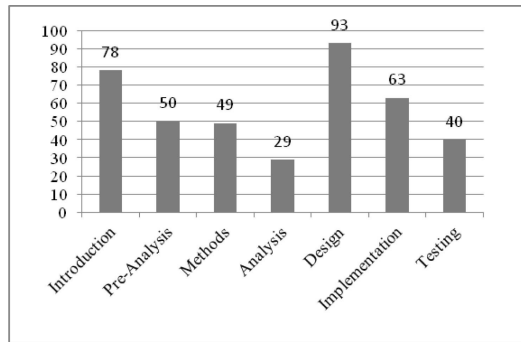
It is a general perception amongst the students

Fig. 3. Questionnaire result. Percent medialogy students stating in which part of the project work they are creative. n = 144.
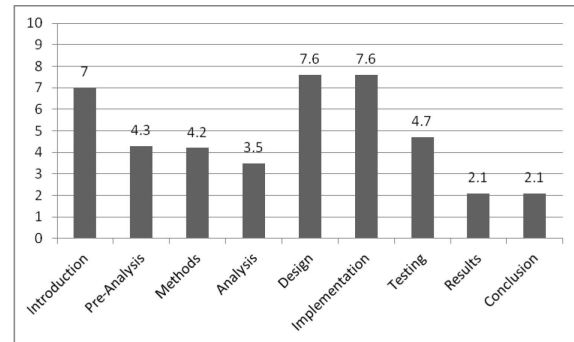

Fig. 4. Average of VAS rating from focus group interview. How creative do you think the different project stages are (0 is not at all creative, 10 is maximum creative) n = 30.

that creativity is high at the beginning of a project, when they have to find their own problem to solve, and in the design stage. However, a wider perspective of creativity is also evident in the process:

> It is especially in the beginning that we are creative . . . but later there will come more ideas. We will make it in another way so there will be something new. The new is where you start to make things—make the product. It is where design meets implementation (Focus group: Male, 6th. Semester student).

In this respect, design may be explained as something new added to a product; this meaning finds parallels with De Bono's definition of creativity [16].

During the focus group, we made the students rate (VAS, 0–10) the level of creativity throughout the different stages in the project. The results are the same as those in the questionnaire. Apart from the questionnaire, we also made students rate the sections of results and conclusion.

The focus group interviews reveal that the students perceive they work most creatively in the beginning of the project and the highest rating was for design and implementation. However, similar to the questionnaire, the analysis part was rated with the lowest score (not taking results and conclusion into account). In the focus group interview we asked more in-depth questions about this perceived missing creativity in the analysis:

> The biggest downside to creativity is the analysis part. So actually we have tried to take this part out of the established theories, and made our own theory. That was rather creative, but I we shouldn't do any analysis. It is not fun (Focus group: Male, 10th Semester).

> The part of finding literature is not at all creative. But in general I think the project work is creative (Focus group: Male, Student, 6th Semester).

> The only stage where I think we do not work creatively is when we find literature and read books and analyse texts. Because there you have to put the academic hat on and think in terms of facts. Everything else is creative, even testing and methods (Focus group: Male, Student 6th semester).

> You can be super creative when you start your project, but then creativity gets limited because we need to test.

> You have so many restrictions, which take down the creativity (Focus group: Female, 10th Semester).

There seems to be a general assumption about the stages in the projects when students find they are creative. We do not have data about the way students work with their analyses, but our experience from being supervisors over many years is that students are creative when they choose, combine and evaluate their data for the analyses. We also know that the analyses are considered too time-consuming—taking time from the technical designs and solutions. This is an opinion amongst both students and supervisors. It is interesting to note in the data that generally the Master's students, more than the Bachelor's students, evaluate the analysis part to be more creative. The reason for this could be that the Master's students start to look at the analysis part in a different way—that there is greater possibility for creating their own theories. Hence, the latter group move from perceiving the report structure as something fixed and restricted to something open for exploring and developing a new structure, which also fits the specific project they are working with in a better way. Additionally, they feel they have a great amount of knowledge, as they start to mix theories and methods in new ways. And, finally, some Master's students begin to have alternative perception of so-called restrictions, which they see as limitations, forcing them to be more creative.

The students do not have a very unambiguous perception of creativity during their project. The reason may be because the perception of creativity is rather individual. Furthermore, the students are not given any vocabulary so they can explicitly connect creativity to the different phases in the project.

5.3 Barriers for being creative

From a philosophical standpoint, it is a goal of Medialogy that students are creative. They can be supported in the courses and by their supervisor during the whole project period.

On the Bachelor's Degree level, there is one optional course focusing specifically on creativity. In their first year the students are also taught some creative techniques in two different mandatory courses. On the Master's Degree level, there are so-called free study activities, and if they find an interesting course they would like to take, this is a possibility.

In general the Medialogy students request further tools of creativity:

> We had this course where the course teacher made coherence between the academic approach and the creative process. But I think there should be further tools and efforts in the first part of the project with further creative ideas (Focus group: Student, 6th Semester).

> Yes, we had one course where we learned to put strange things together. We haven't used it directly, but we have used this idea of not saying no (Focus group: Student, 6th Semester).

Some of the students also mention the collaborative group work as a barrier to their creativity:

> You are so limited in your creativity based on the people you work with (Focus group: Male, 8th Semester).

> It is also limited to the persons involved in the project. There are some examples where you do not implement things because not everybody could defend it for the exam (Focus group, Male, 8th Semester).

> Since people are creative in different ways, we don't get to work with the field of creativity until maybe the 5th semester (Questionnaire, ID 106, Female, 3th semester).

Nevertheless, this attitude might have something to do with their perception of creativity, which is understood as enhanced within a collaborative project group, and where creative group activities are assumed to be more productive than individual efforts. That said there is much research showing that group work does not necessarily lead to more creativity than individual work [28, 29].

One or two supervisors are connected to the students' project work. The supervisors are all academic experts within their fields, and they have to supervise according to the PBL concept, although there is no explicit claim that they have to support the students' creative processes. The students in their interviews stated that they did not get much support from the supervisors when it came to creativity.

> I don't think supervisors encourage creativity. It is not like they come and say: try this in this or that way and see if something funny will happen. I have never experienced that (Focus group: Male, Student 6th semester).

> But it is individual. Some are very controlling and some do not say anything, and lead you directly towards the cliff . . . but often they present something they know—like a theory they know . . . very seldom they ask if we

have thought of having another angle. This I haven't seen yet (Focus group: Male, Student 6th Semester).

It seems that students have an explanation as to why supervisors do not use more creativity in their supervision. The supervisors know the study plans, the academic levels and what can be achieved within the time frame, and this will be a barrier to creativity.

> We have to use theories and methods so when you are stressed by time and deadlines you cannot be creative. . .we are told how to make it good. . .there is a clash between creativity and the academic world (Focus group, Female, Student 10th semester).

> In Medialogy the creative process is usually overruled by the need to achieve academic goals. It is primarily the supervisors telling these needs for academic stuff (Comment from questionnaire, ID 1, Male, 7th semester).

Students may not be explicitly encouraged to be creative by their supervisor when working on a project, but the whole ethos of Medialogy is based on the creation of new and exciting projects. The incentives are awards, videos on the webpage, etc. And when analysing the students' projects, we can see many examples of lateral thinking [16].

6. Discussion and conclusion

In this case study, we have evaluated Medialogy students' perception of creativity. This evaluation is based on their judgments with reference to their normative criteria. This conception of creativity is also understood in terms of current values and norms, which is influenced by several variables. Creativity is a dynamic process, in which both individual as well as context dependent factors interact. In Medialogy, the focus is explicitly on the little-c creativity, which also influences the students' perception. Their views of creativity differ, but in general they connect it with the little-c creativity, designing new technological solutions to existing problems in an everyday life context. The Medialogy students regard positively both the education and their self-concept as regards creative abilities, especially in the collaborative project work. Students find they are creative to varying degrees in the different project stages. In particular, the beginning of the project, design and implementation are seen as highly creative stages. Students perceive the PBL principles and study guides as barriers for creativity. Hence, the overall experience is that the restrictions and rules set by the study guide as well as supervisors' expectations of the academic level lead to the assumption amongst students that it is difficult to be creative during the whole project. When students are at the Master's level, they can see restrictions as challenges and

possibilities for creativity, which might be because they have more experience and knowledge within both project work and specific disciplines.

It appears that the Medialogy students have difficulties expressing the means of creativity; in other words, they are not able to see creativity at all stages of the project work because the students are not given a vocabulary so they can explicitly express creativity and see coherence with the PBL principles and creativity. At the same time, it might also be the case that the students have different perceptions of creativity through the different project stages, which could be included in future research.

The findings highlight a need for further courses in creativity where students acquire expressions, knowledge and experience in terms of both the concept of creativity and practical tools. It is also important to make these courses in coherence with teachers and supervisors so there are possibilities of enhancing creativity.

The interaction between supervisors and students is very important in this sense, but even more significant is to adopt a holistic perspective including the organization of teaching, curriculums and the coherence between PBL and creativity.

This study is limited to the educational and cultural context of Danish students in the Medialogy program at Aalborg University Copenhagen. The data were collected between November 2010 and March 2011. At this time, Medialogy had just implemented a new curriculum, which might influence student perception of creativity, as well as the barriers. The new curriculum includes several changes that incorporate problem-based creative learning in ways that overcome many of these limitations. Next steps within this research project might include additional user studies based on engineering and art students drawn from outside of the Medialogy education. One aspect of such studies might include a comparison of engineering versus artistic creativity. Another important element we intend to look at is how students' are assessed for creative knowledge, skills, and competencies. We also plan to further examine the perceptions, skills, and barriers to creativity from the teacher's perspective.

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