

Entrepreneurship Education for Engineering Students – A Survey of Former Students’ Self-Employment and Market Attraction

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Abstract—Engineering students will meet a working life with great expectations and demands of creativity, innovation, and entrepreneurial skills. They will need to demonstrate abilities like business knowledge, management, marketing, finance, and networking. The objective of entrepreneurship education at University of South-Eastern Norway, Faculty of Technology, Natural Sciences, and Maritime Sciences (USN-TNM) is to prepare students for self-employment or to be a highly appreciated employee in an established company. The entrepreneurship program started in 2004 with a 20 ECTS course called Student Enterprise. In the period 2004 to 2015, 242 students have succeeded taking the Student Enterprise course from USN-TNM. The Student Enterprises consist of 3 to 6 members and they have to invent and develop their own business ideas, market, and possibly sell technological products or services. An important part of the entrepreneurship education is to participate in regional and national competitions in order to enhance presentation skills and customer relations. A comprehensive survey was conducted in order to investigate former student’s self-employment and market attraction. Students graduated from 2005 to 2015 were asked to respond to a survey and a total 46 % response rate was achieved. The survey included questions like time from graduation to employment in a company, the professional relevance in the first job, benefits of entrepreneurial competence in work tasks, benefits from experience with competitions, and if they had started up their own enterprise. The survey shows that the overall satisfaction with entrepreneurship program have a total average score of 4.2 of 5. 12% of former students have established their own enterprise, which is quite high taking into account these student’s high market attraction.

Keywords—*student enterprise, competitions, presentation skills, business knowledge, entrepreneurial attitude*

I. INTRODUCTION

Industry and working life are changing rapidly. The need for entrepreneurial skills and competence among engineers are crucial for viable business, and is crucial to be a part of higher education. Different effects from entrepreneurship education has carried out as results of this, like economic growth and job creation [1]. It is valuable for all employers to have entrepreneurial competencies to accommodate the uncertain and fast moving world, and entrepreneurial courses in higher education are a response to this need [2]. In addition to the common economic development and job creation connected reasons to contribute entrepreneurial education, there is also

a less common but increasing emphasis on other effects. For instance, the effects entrepreneurial activities can have on students’ and employees’ perceived relevancy, engagement, and motivation in both education [3] and in work life [4].

Entrepreneurship is about opportunity identification, business development, self-employment, venture creation, and growth, i.e. becoming *an entrepreneur* [5-6]. In higher education there are several ways of teaching entrepreneurship; (1) teaching “about” entrepreneurship, a content-laden and theoretical approach aiming to give a general understanding of the phenomenon, (2) teaching “for” entrepreneurship, an occupationally oriented approach aiming at giving budding entrepreneurs the requisite knowledge and skills, and (3) teaching “through” a process-based and often experiential approach where students go through an actual entrepreneurial learning process [7]. The first one is the most common approach in higher education institutions [8]. At University of South-Eastern Norway, Faculty of Technology, Natural Sciences, and Maritime Sciences, campus Porsgrunn (USN-TNM), we have chosen teaching “through” entrepreneurship.

Learning and value creation is the main goal within entrepreneurship education, both in general and at USN-TNM. To create value to outside stakeholders will then develop entrepreneurial competencies to the students, regardless of whether successful value creation is being achieved or not. This is not just “learning-by-doing” and “problem-based learning”, but “learning-by-creating-value” approach grounded in the field of entrepreneurship [9].

Four types of action-based pedagogy, a question scheme, and some examples of pedagogical approaches [10], presented in a progression model showing the further you get into the model the higher the potential student motivation and engagement, but also increasing the teaching complexity. It is important that the pedagogical approach is not only project-based learning, but also for creating value to outside stakeholders. The common business plan focus in entrepreneurial education [11] by itself does not create value to external stakeholders but rather often becomes a deliverable to the professor. Such as a team based approach, a focus on value creation, connecting the students to the

outside world and letting students act on their knowledge and skills have been highlighted as important features. Service-learning is an example of a value creation approach where value is created to the surrounding community. Service-learning is defined as an experiential education approach that is premised on “reciprocal learning” where learning flows from service activities, both those who provide service and those who receive it “learn” from the experience [12]. Service-learning occurs only when both the providers and recipients of service benefit from the activities.

Action-Based Entrepreneurial Education (ABEE) [13] can be seen as a part of service-learning. ABEE is where students are faced with real-life challenges through the discovery, development and evaluation of a concrete business idea into a business opportunity. The teaching methods used are more action-oriented and learning by doing, moving away from teaching individuals in a classroom. The learning-by-doing activities are usually taught in a group setting and in a network context. The goals of an ABEE are often 1) establishing new ventures and 2) educating entrepreneurs. The New Venture Planning (NVP) pedagogy is a part of ABEE where students have to pitch their business idea in external arenas and at the end of the course have to present their business plan to “business investors” and relevant external partners (for evaluation, final assessment, and grading). This creates time pressure and uncertainty, which means aligning the pedagogy with close to real “entrepreneurial learning” by letting the academic performance and grading be directly linked to project fulfillment and success. Fig. 1 shows a general model describing an NVP course consisting of four generic phases [14].

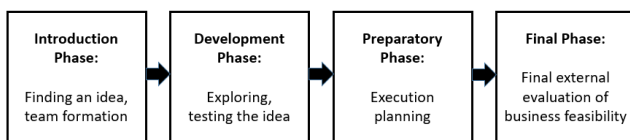


Fig. 1. A generic model for a New Venture Planning (NVP) course [14].

In NVP courses, students work on real problems that have no clear answer or solution. Instead, they create a social learning context that offers an opportunity for students to learn from trial and error and to grow personally in collaboration with their peers. However, in order to maximize the entrepreneurial learning experience, it depends very much on the educators how this learning process is organized.

Entrepreneurial competencies are defined as knowledge, skills, and attitudes that affect the ability and willingness to do the entrepreneurial job of new value creation [15-18]. There are similarities between the outlined entrepreneurial competencies and what are “non-cognitive factors”, such as perseverance, self-efficacy, learning skills, and social skills [19].

Self-efficacy, as one of the most important “non-cognitive factors” is the belief in one’s ability to perform certain tasks successfully, and entrepreneurs score significantly higher on self-efficacy than non-entrepreneurs [20]. Self-efficacy which can be translated into self belief, self assurance, self

awareness, “I can”, and feelings of empowerment – is essential for both social learning (acquiring appropriate positive attitudes) and social confidence (believing in one’s idea and wanting to take it forward). Self-efficacy is a very important part in the entrepreneurship literature as a crucial personal attribute of people who recognise and exploit opportunities. Successful entrepreneurs feel that they can control their own success [21]. Students with high self-efficacy have the belief in becoming employed and therefore have a higher market attraction.

From 2004 to 2015 Student Enterprises from USN-TNM have received nine awards in European championships, 43 awards in national championships and 88 awards in regional championships [22,23].

In this paper, we therefore aim to understand: How entrepreneurship education impact engineer student’s self-employment and market attraction. Building upon information from 11 year period of survey about how relevant education in relation to their first job and benefits from entrepreneurial skills in relation to their first assignments. We want to investigate these results and see if we can make a contribution. We finish with discussion of some identified themes which may give direction for future study.

II. METHODOLOGY

A. Program Description

The entrepreneurship program at USN-TNM, bachelor of engineering, started in 2004 with a 20 ECTS course, but has evolved to consist of three courses. At present, the entrepreneurship education starts in 1st year with a 10 ECTS course, Project Methodology, IT Tools, and Finance. In 3rd and final year of the bachelor program the students are offered the voluntary courses Entrepreneurship (10 ECTS) and Student Enterprise (20 ECTS).

In this paper, however, we only have focus on the former students taking the Student Enterprise course. More information of the description and philosophy of the courses and can be found in [22]. To summarize from this reference the teaching method is based on the learning “through” processes and many milestones. This is described as a (3) way of teaching entrepreneurship in the Introduction. The students are expected to be independent and to start up their own business idea. Some constraints are given from USN-TNM, but only that the business idea should have a technological aspect in solving a concrete need that people or the market may have. Normally this is a technological product, but it is also possible with a service on a technological platform. The Student Enterprises pedagogical methods have evolved since 2005 and today the network of participants of the pedagogical tools is shown in Fig. 2.

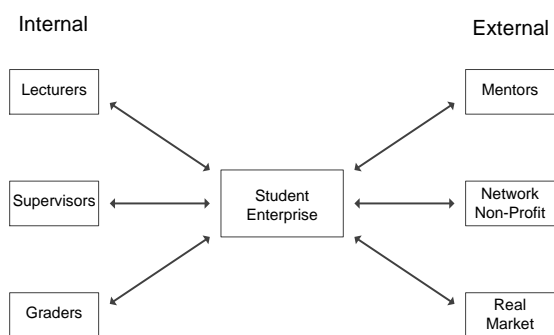


Fig. 2. A sketch of the internal and external network at USN-TNM, [22].

Table I shows the main content of the important milestones in the course. There is a focus on competitions. This pedagogical method is discussed both in [14] and [23]. In ref. [14] this model of teaching is compared to a less competition based pedagogical method from another university, Norwegian University of Life Sciences (NMBU).

Engineering education in Porsgrunn, Norway has since 1982 been based on a pedagogical model where project skills have been emphasized through the study. The model is based on pedagogy from University of Aalborg in Denmark. Professor Knud Illeris describes the acquisition of learning content, personal development, and the cultural and social nature of learning processes [24].

Projects where students play an important role in goal definition, planning, and organization are important to ensure stronger ownership to own learning. Entrepreneurship education at USN-TNM has pedagogical tools from Problem Based Learning (PBL) [25].

In this paper, we therefore aim to understand: How entrepreneurship education impact engineer student's self-employment and market attraction. Building upon information from an 11 year period survey about how relevant education in relation to their first job and benefits from entrepreneurial skills in relation to their first assignments.

Table I. The most important events of Student Enterprise courses in 3rd year of the bachelor program.

Activity, Organizer	Date
Registration as Student Enterprise, The Register of Business Enterprises	Oct
Springboard@ competition, Connect	Nov
Thesis with business plan	Nov
Two Minutes to Convince competition, USN	Mar
Venture Cup Business Plan, Start, Norway East	Apr
Student Enterprise Championship, Junior Achievement (JA) Telemark	May
Annual general meeting	May
Student Enterprise Norwegian Championship, JA Norway (if qualified)	Jun
<i>Student Enterprise, after grading</i>	
Europe Enterprise Challenge, JA Europe (if qualified)	Jul
Venture Cup Norwegian Championship, Start, (if qualified)	Oct

The Student Enterprise course gives the students knowledge about business establishment, including the start-up, management, and liquidation of their enterprise. For help and support along the way, USN-TNM provides two supervisors,

as well as mentors from business life. The students gain valuable skills and attitudes for entrepreneurship and teamwork and learn how the market responds to their business ideas.

B. External Contacts

Entrepreneurship is to develop a profitable business from an idea. A successful entrepreneur must understand and master several fundamental knowledge and skills like business planning, marketing, communication, funding, finance, management, and partnership.

In order to succeed with all these important challenges, network and business partners are required. Students must select their own mentors as a first step to creating a network. During the Student Enterprise course, they will participate in at least five different competitions, facing feedback from professional juries. An entrepreneur must continuously listen and learn from criticism and good advice in order to improve his/her business.

USN's network has expanded over the 11 years since start-up of the course and the network is considered as an important success factor. To be challenged by professional partners, whose goal is to improve the students' business, is good training for meeting the real market.

Telemark County Council and USN-TNM have signed a partnership agreement. The agreement applies to several areas of cooperation, including entrepreneurship. Telemark County Council has designated Junior Achievement (JA) as the operator for entrepreneurship in higher education in Telemark. Connect Norway and USN-TNM have for some years arranged a Springboard@ and Elevator-pitch for all Student Enterprises, similar to ordinary start-up enterprises. Grenland Friteater, a theatre established in 1977, is an important resource for improving the student's communication skills. University of California, Berkeley has from 2014 had both a supervisor and a mentor role preparing the Student Enterprise groups at USN-TNM [26].

Within this course, students are challenged to be action oriented, proactive, creative, how to organize, and find their role identify. By this they also develop their entrepreneurial attitude.

C. Survey

A survey has been conducted to obtain data from the students in the course Student Enterprise. The survey consisted of 5 questions with a bipolar scale and one question for free comments. The collection of data were performed by phone calls, emails, and Facebook and a trained telephone assistant with former experience as Student Enterprise student at USN-TNM conducted the survey. The five questions were: i) How easy did you get your first job after the bachelor degree? ii) How relevant was your first job? iii) What benefit did you achieve from taking the Student Enterprise course in your job(s)? iv) Did you have any benefits from the competition experience of the Student Enterprise course? v) How satisfied

are you overall with the experience from the Student Enterprise course?

In addition, the survey received information from the engineering program, what background the students had at high school level, the year of bachelor diploma, the present employer, and if the student had started his or her own company.

III. RESULTS

From 2005 to 2015, 242 students have graduated from USN-TNM's entrepreneurial program, representing 75 Student Enterprises. Each Student Enterprise consists of 3 to 6 members. 112 out of 242 former students responded to the questionnaire and the results from these students were used for further analysis. Fig. 3 shows that the number of respondents who have followed the Student Enterprise course and who have participated in the survey varied a lot from one year to another.

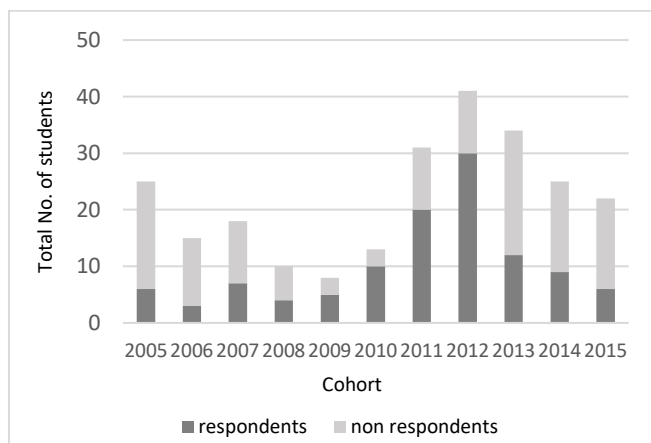


Fig. 3 Number of students responding to the survey in contrast to the number of students per year.

The student's responses to the survey varied from 20 % to 63 %. The average response rate was 46 %. There was somewhat low participation during the period 2007–2010. The numbers increased significantly up to 2012. From fall 2014 the Student Enterprise course split into two courses: Entrepreneurship in the fall semester and Student Enterprise in the spring semester. Some students chose not to continue in the spring semester and chose a more traditional bachelor thesis.

Table II shows selected feedback given by some of the students on entrepreneurship education after graduating. Some of the positive feedbacks, pros, shows that the entrepreneurship courses (Entrepreneurship and Student Enterprise) has made a difference and changed their skills and attitude. It indicates that the student who responded: "I experienced that I can achieve whatever I want if I really go for it" has achieved a high self-efficacy, which increases the student belief in one's ability to perform certain tasks successfully [20]. We can also see high impact of self-efficacy in the other positive feedbacks, as if they feel they can control their own success, which does not depend on others [20].

Table II. Feedback quotes from former students on the Student Enterprise education.

Pros	Cons
<p>Student I "I experienced that I can achieve whatever I want if I really go for it".</p> <p>Student II "My employer told me that I have never got this job without my competence in Student Enterprise".</p> <p>Student III "Entrepreneurship and Student Enterprise is highly appreciated when applying for a job".</p> <p>Student IV "The knowledge and competence I gained in the courses Entrepreneurship and Student Enterprise are the most beneficial of all courses in my new job".</p> <p>Student V "The course Student Enterprise has without doubt improved my professional and personal skills. I am very pleased and will highly recommend this course to other students".</p>	<p>Student VI Not all supervisors had sufficient skills.</p> <p>Student VII The objectives with Student Enterprise education were good, but the course organization was not satisfactory.</p> <p>Student VIII I am mostly satisfied with the course Student Enterprise. But it should have been a requirement that business ideas should be relevant to the study programs. Many employers focus on the bachelor thesis and not Student Enterprise skills.</p>

The negative feedbacks, cons, are more about how the course was organized, or having professors with skilled and educational learning approach and knew how to run ABEE. According to [10] the highest level of action-based pedagogical approaches have strong influence on the students' motivation and engagement. However, this also may result in high teaching complexity, that can cause the challenges stated by student VI-VIII in Table II.

Fig. 4-8 show the results of the survey showing average grading per cohort. Fig. 4 shows how easy it was for the students to get their first job. The average grading per cohort were typically above 4 and some cohorts close to maximum 5, except for cohort 2015 which where 3.5. This indicates that students easily got their first job.

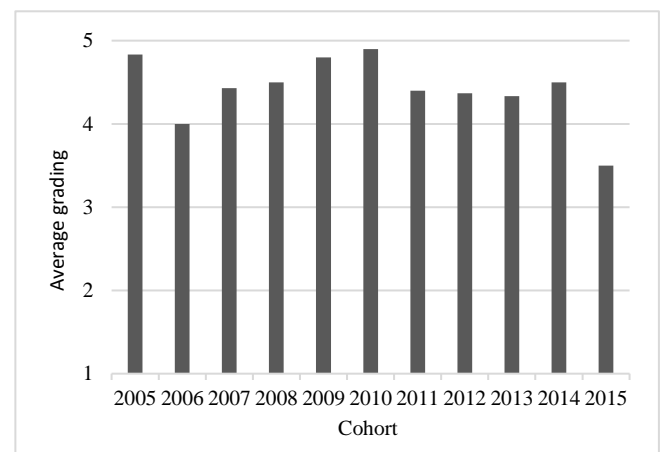


Fig. 4. Question No. i) How easy was it to get your first job?

There is a strong connection between students' market attraction, how easy it was to get your first job and self-efficacy [20]. This also reinforces and confirms that the Student Enterprise course might have had a positive impact on students' skills and attitudes.

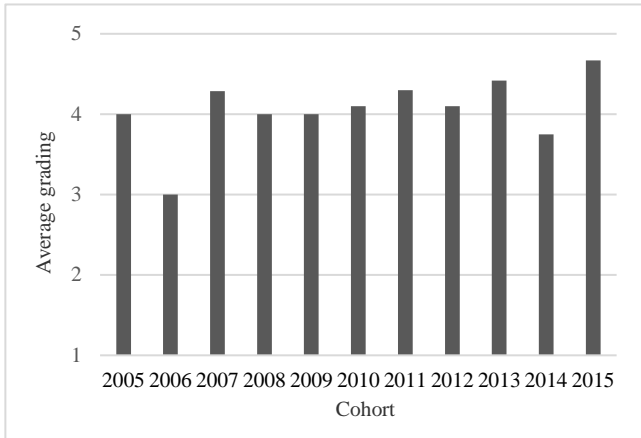


Fig. 5. Question No. ii) How relevant was your first job?

Fig. 5 indicates how relevant the first job to the student in relation to the education they had taken. The typical average grading per cohort was around 4, except for 2006 where it was 3.0. This indicates that the students attending Entrepreneurship course(s), not only easily gained his or her first job, but also found relevant work in their first job. This may indicate evidence that students having entrepreneurial education have an even stronger market attraction and ease to get a relevant job.

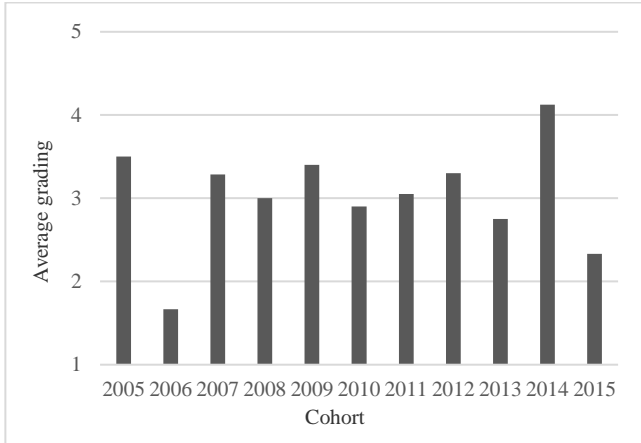


Fig. 6. Question No. iii) How beneficial is Student Enterprise education in your daily work?

Fig. 6 shows how beneficial Student Enterprise education is for the students in their daily work. This question had a lower result than the previous questions. Most cohorts had an average around 3, except for 2006 where it was very low. 12 % of the former students have established their own enterprise, which can explain the low result on question iii). The former students, who did not establish their own enterprise, 88 %, did not seem to fully understand the importance of the experience from the Student Enterprise. They did not find any relevance or similarity with the tasks they do as an employer and the tasks they did as a student in Student Enterprise.

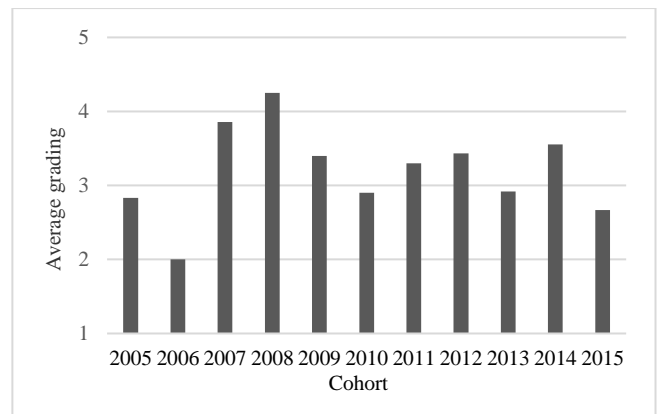


Fig. 7. Question No. iv) Is experience with Student Enterprise competitions helpful in your present work?

Fig. 7 shows if experience with Student Enterprise competitions was helpful in students' present work. Many students found competitions with an audience and professional juries demanding and out of their comfort zone. Just a few student enterprises will succeed and most students might thereby give a low score on satisfaction with competitions. The total average score was 3.2 while the winners in Norwegian and European championships gave a total average score of 3.6.

Fig. 8 shows how pleased students were in total with Student Enterprise education and the results of this question appear on the upper part of the scale. Why? This is quite strange as the two previous questions got much lower scores. The reason for this, a new scenario, is that the students gather all their impressions about what they are left with and what they have learned – and then it turns out they were very satisfied. On the previous questions, iii) and iv), it is indirectly asked about knowledge and skills, while in this question, v), it is a collection of both knowledge, skills, and attitudes, and perhaps that is reason that the course got a high score from the students, and that they responded much higher here.

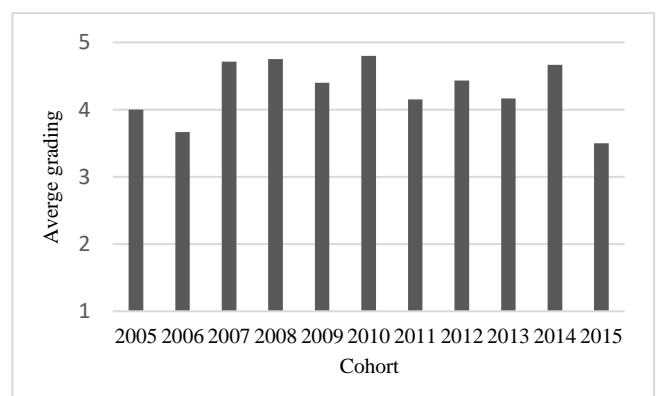


Fig. 8. Question No. v) In total how pleased are you with Student Enterprise education?

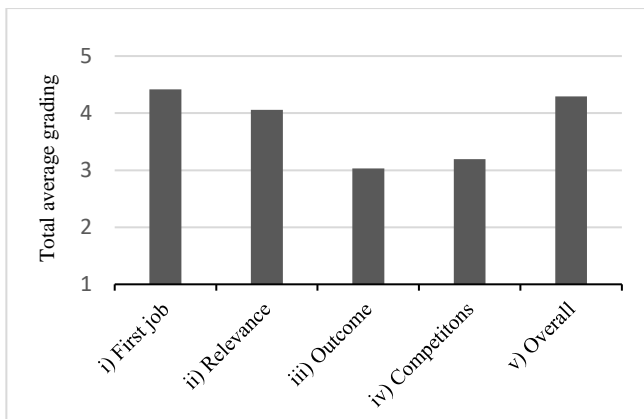


Fig. 9 Total average grading over 11 years with Student Enterprise.

In Fig. 9 a total average grading over 11 years with Student Enterprise is shown for each questions in the survey. The students gave a high score on how easy it was to get their first job and the relevance of their education as an employee. This indicates that students with entrepreneurship skills were attractive among employers. The question about overall satisfaction is a summary of the total satisfaction with Student Enterprise course and the total average score is 4.2. The score on outcome of Student Enterprise education and experience with competitions are significantly lower than for the other three questions. It does not seem that the students realize or fully understand the diversity of skills acquired during entrepreneurship education.

IV. DISCUSSION

The goal of this study was to explore former student's self-employment and market attraction. In some years the number of students and the number of responses to the survey are limited which makes the average grading sensitive to a few former students experience with Student Enterprise education.

The Student Enterprise course at USN-TNM is using competitions and business partner networking as important pedagogical tools. Presentations and competitions are meant to prepare the students for real work life presenting business proposals and meeting demanding customers.

As described in Fig. 4 most of the students give a high score on ease to get their first job after graduation. The cohorts 2006 and 2015 do however stand out with a lower score than typical average. In the 2006 cohort only three former students responded to the survey. The average grading in 2006 is thereby based on very few respondents and the statistical data from this year is questionable. Employment rate among engineers has cyclical dependence and in 2015 Norway faced a significant reduction in oil business investments due to large-scale shale oil production in USA, reduced export to China and OPEC's decision not to reduce oil production [27]. These events led to major reductions in oil related industries and layoffs. A consequence was that students from the 2015 cohort had more difficulties to get their first job than previous cohorts had.

The score on relevance of education in the students' first job has an average grading of 4 as described in Fig. 5. Students from cohort 2006 give a significantly lower score than average and as previously described, only three students responded to the survey. Students from cohort 2015 gave a higher score on job relevance than average even though the same cohort had a lower score on how easy it was to get their first job. The employment rate in 2015 cohort was lower than average, but those who got jobs were satisfied with job relevance.

The perceived benefit of entrepreneurial education is presented in Fig. 6. 12 % of former students have established their own enterprise and their average grading on benefit with Student Enterprise education is 3.9 while the average grading for all students is 3.0. Most of the students are employed in established companies and do not seem to fully understand benefits with Student Enterprise compared to those who have established their own company. A scenario here, and an explanation of why such low and medium score, is that the students maybe answering this question are thinking specific about the activities around starting an enterprise and what this entails, instead of thinking about which attitudes, skills, and knowledge received, and that can be used in the upcoming job they have.

The Norwegian business has however, a great demand for new graduates with knowledge and competence in entrepreneurship and Student Enterprise skills. Johan H. Andresen is owner and chairman of Ferd Enterprises which is one of the largest privately held companies in Norway. He has been a board member in JA-Norway and is the founder of Ferd Award. Ferd Award is awarded to the Student Enterprise with the highest international potential for business in the national championship for Student Enterprises. Ferd Award and Best Student Enterprise ensures participation in the European Championship. USN-TNM students has won this award 10 times since 2005. Johan H. Andresen states that "Student Enterprise gives challenges and responsibilities to those who seek it, possibility to deal with risk- and opportunities and willingness- and skills to create business values. These are the students Ferd are seeking".

Satisfaction with competition skills are presented in Fig. 7. Many students find competitions with an audience and professional juries demanding and out of their comfort zone. Just a few Student Enterprises will succeed and most students may thereby give a low score on satisfaction with competitions. The average score is 3.2 while the winners in Norwegian and European championships give 3.6. Presentation skills, ability to have focus on the few and important items and to get attention from audience are important competences in business life. USN-TNM has probably not primed the students satisfactory in order to benefits of competition skills.

Overall, satisfaction with Student Enterprise education in Fig. 8, has a high score, higher than the previously questions which is rather strange. One of the reasons might be how the questions are asked, and therefore the results on the various issues have become so diverse. In retrospect, the questions in the survey could have been improved or changed. For

example questions ii)-iv) could have been more directed towards asking them about how the course had changed or affected their skills and attitude. An example of how to ask the question could have been around questions iii) about more how Student Enterprise competition had affected their way of being creative or how to handle stress and uncertainty under pressure? In this way, we could have changed the focus more on how the course had affected students' attitude and skills, non-cognitive, and not the concrete activity. There are several possibilities for improvement with the collection of data in this survey, which could have affected especially the outcome of question i) and ii). The students who had not taken the entrepreneurship education could also have been included as a part of the survey, as a reference group. By this, it could be possible to have an indication or not if the Student Enterprise education has made a difference. One could also have thought of another reference groups like e.g. from another educational institution, nationally or international, to see if the USN-TNM stands out somehow.

V. CONCLUSIONS

The objective of this study was to explore former student's self-employment and market attraction. Building upon information from an 11 years period of surveys about how relevant entrepreneurship education is in relation to their first job.

We claim that this study signals that there has been a change in student's self-employment and market attraction by giving students entrepreneurship courses like the course Student Enterprise. The quality of teaching, teaching methods, moving more to active learning and competitions, which have managed to improve students' professional performance, skills and attitude. There are also signals that there is a need to transform the different activities in the course, like the competitions, to show what these activities affect the students' entrepreneurial skills and what they really means. In the future these courses might contain more reflection and analyzes of own learning processes, and how new skills are developed. By using new teaching strategies to get students primed before attending a competition by discussing the question "Why are we doing this?" This important question helps students understand the relevance and importance of the activity and how this experience and new skills can be used into other similar activities in their future carrier job.

These findings have important implications for the further development of the entrepreneurship courses like Student Enterprise and other innovation courses at USN. We hope that this research provides guidance and insight to stakeholders in higher education. It is critical that we continue to research the effect of entrepreneurial skills and attitude in increasing students' self-employment and market attraction. In the future, we can hope for increased understanding of entrepreneurship education and how it can be integrated into education in several courses at the university level, not only in separate courses. More research is needed on how this should be done and how to change methods for learning, so we better can understand the most effective means of

supporting the career-related and psychosocial needs of future graduates.

VI. ACKNOWLEDGMENT

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