

Applying entrepreneurship as a learning design for engineering education

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ABSTRACT: Limited job opportunities in industries result in the continually increasing number of graduates from engineering educational institutions having difficulty finding a job. A viable strategy to develop is to encourage entrepreneurship in the learning design for engineering education. It is expected that by undergoing practical learning in combination with entrepreneurship, engineering students may gain practical experience and have an entrepreneurial spirit, so that they can become great entrepreneurs. In this article, the author explains about entrepreneurial education, entrepreneurial intention, and focuses on learning design, which develops entrepreneurial skills through practical teaching in engineering education. This design involves student activeness and student-oriented learning in which teachers serve as facilitators in motivating their students to accomplish learning purposes agreed on by both teachers and students. The full support of leaders, faculty members, staff and stakeholders is instrumental in serving this purpose.

INTRODUCTION

Learning processes in engineering education take place through two kinds of learning: theoretical and practical. The former is done in classes in which students listen to teachers' explanations and the latter is done in a laboratory. Recently, practical learning in engineering education has developed products that command only a low selling price [1][2]. Such products are left abandoned after the learning has finished, which imposes an onerous burden on the institutions, due to the great expense incurred for practical learning, including budgets for materials, electricity and supporting devices [3-5]. What is more, the products' lack of a good quality standard worsens this condition. This will badly influence students' creativity, responsibility, motivation and competitiveness in making products during their learning.

Given the poor conditions under which engineering education institutions find themselves motivated the author to draw up a learning design by applying entrepreneurship. The aim of learning design by applying entrepreneurship is that the engineering education students have entrepreneurial spirit with which to make products having a high sale price. To achieve this aim, technical colleges may work in collaboration with industry. According to Sjøvoll, students' entrepreneurial flair should be developed as soon as possible through learning processes [6]. This enables them to be directly involved in creative processes [7][8] and to be equipped for independent life in the future [9][10].

It is expected that students should have practical experience of industrial processes, such as designing products, estimating production costs, manufacturing goods, evaluating product quality, packing products and managing income from selling products. In this learning design by applying entrepreneurship, the students play decisive roles in all processes, whilst teachers play supporting roles as supervisors.

ENTREPRENEURSHIP EDUCATION IN ENGINEERING EDUCATION

Entrepreneurship education may be provided to engineering education students to improve and develop their entrepreneurial skills [11-18] so that they can work independently [19]. It is ideally suited to providing the students with personal entrepreneurial capacity to handle problems of uncertainty and complexity in their future work and personal life [20-22]. They need personal entrepreneurial capacity, including skills in founding commercial organisations in supporting effective entrepreneurial actions [23]. This focuses on the implication of the discussion and characteristics of learning processes of engineering educational institutions [23-26].

The widely held view of entrepreneurial education stresses teaching contexts on pedagogy and the organisational processes needed to support entrepreneurial skills, and attributes of various disciplines and multi-disciplines [27][28]. Entrepreneurial education in the term of intra-disciplines involves all staff, students and the university in learning

processes [29]. This needs organisational structures to support the introduction of the entrepreneurship concept to the institution [30], for it is not merely a model of conventional business schools [31].

Subsequently, good practice in entrepreneurial education to ensure that graduates can develop their entrepreneurship is aided by developing students' entrepreneurial behaviour, attitudes and skills, and providing them with key entrepreneurial competencies [32]. This will motivate and help them to have professional careers or to be involved in promoting new business enterprises. Gibb has mentioned four steps of entrepreneurial education leading to specific results, explained as follows [33].

The first step is to develop entrepreneurial behaviour, attitudes and skills. The expected results from this step are opportunity seeking, initiative taking, ownership of a development, commitment to see things through personal focus of control (autonomy), intuitive decision making with limited information, networking capacity, strategic thinking, negotiation capacity, selling/persuasive capacity, achievement orientation and calculated risk-taking.

The second is to generate motivation for an entrepreneurial career. This step is supposed to result in the understanding of the benefits of an entrepreneurial career, a comparison with an employee career, some *heroes* as friends, acquaintances and images of entrepreneurial people, just like them.

The third is to understand processes of venture creation with which it is expected that students and graduates can go through the total process, know what challenges at each stage will be and know roughly how to handle them.

The last is to develop generic entrepreneurship competencies. It is expected from this step that students and graduates will know how to find an idea, how to appraise an idea, how to see problems as opportunities, how to identify the key people to be influenced in any development, how to build the know who, how to learn from relationships, how to assess business development needs, where to look for answers, emotional self-awareness, how to manage and read emotions, how to handle relationships, and how to constantly see yourself and the business through the eyes of stakeholders and particularly customers.

Entrepreneurial education given in an institution may be through both intra-curricular and extracurricular activities and competition-based business plans. Intra-curricular activities may involve guest speakers or professors, compulsory modules or partial ones, carrying out projects of practical lessons, industry placement and business simulation games.

Extracurricular activities may constitute entrepreneur forums, commercial and mentoring programmes, weekly business, student exchanges and workshops. In addition, the competition-based business plan can be implemented through competition for students' business, the involvement of engineering education in marketing processes, the allocation of funds for engineering education to make innovation, to set up workshops and to develop initiatives [32][34].

The entrepreneurial education programme should be carefully planned through identification of students' skills and field of knowledge considered to be important to be included the programme. The basic skills and field of knowledge identified are creativity, innovation, communication skills, ability to find opportunities, develop business plans, assess risks and profits of business, promote ideas and attract customers. In the first stage of the programme, students need to be provided with skills and extensive knowledge of managing human resources and responding to business failure, and knowledge of self-development, entrepreneurial roles and legal rules [32].

ENTREPRENEURIAL INTENTION

Intention is someone's motivation to make an effort or take a conscious decision [35]. Entrepreneurial intention is someone's motivation to make a conscious decision to establish a business venture. Thompson defined entrepreneurial intention as someone's knowledge of his/her self-confidence to establish a commercial venture and intentionally plan to do so in the future [36]. Therefore, it is related not to a question of what, but to a question of how. Business connection, additionally, is highly instrumental in strengthening someone's entrepreneurial intention [37], which functions as a catalyst for an action [38].

According to research results, intention can make reliable predictions about actual actions as a form of control over other actions and applications [39-41]. Some writers also stated that the decision to be an entrepreneur and establish a profit-making organisation involves a thought process and a firm plan intentionally devised [42-45]. Entrepreneurship is a good example of intentional actions which can be used as model intention [38][42][44][45]. Intention serves as the best indicator of planned actions, especially, for the entrepreneurial education programme [46].

Given the explanation above, the concept of entrepreneurial intention is often used as a measure for entrepreneurial programmes. Actually, it is not always practical for detecting how many students eventually establish a real business, for this will take a long time. However, entrepreneurial intention can help measure direct effects of the programmes, which concentrate students' entrepreneurial intentions on the establishment of their own business ventures [47].

ENTREPRENEURSHIP AS A LEARNING DESIGN

Making entrepreneurship a learning design is not so easy and every single process should be carefully planned. The process includes designing syllabuses, learning activities and evaluation process. In order for this learning design to work properly as planned, professors, administrative staff and stakeholders should be involved in it. As shown in Figure 1, the design is consecutively implemented by devising syllabuses and building up financial supports, making plans and implementing them, encouraging reflection, completing final products, stimulating selling process, carrying out evaluation and obtaining additional finance.

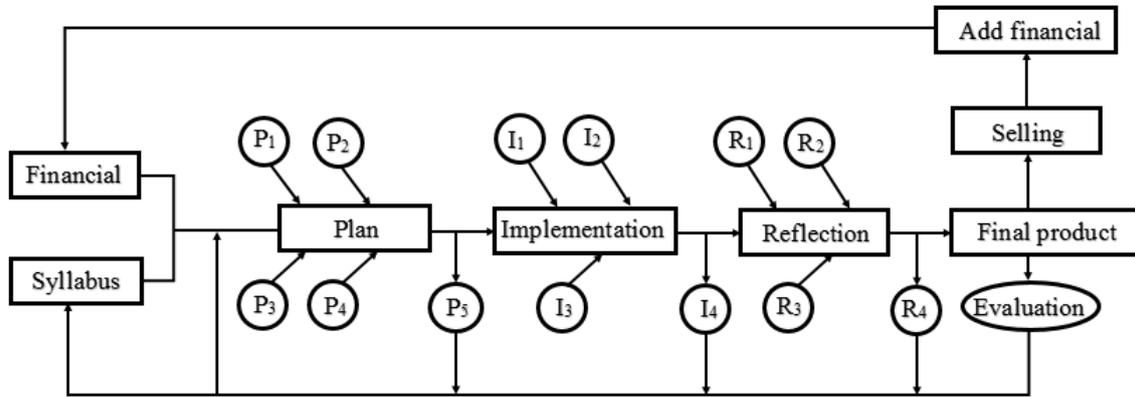


Figure 1: A learning design of engineering education encouraging entrepreneurship.

The syllabus for practical learning devised by teachers, includes: learning purposes, practical learning, lesson subjects, reference sources, learning methods, tools of learning, devices and materials needed during the practical learning, periods of practical learning, and the final result of the practical learning established for a semester. In addition, teachers should develop the main themes in accordance with the programme materials and those in accordance with students' creativities.

The next action is making a plan. The planning process is one of the first steps in this learning design by applying entrepreneurship, which must involve students taking practical learning. It includes P₁ - P₄. P₁, the forming of working groups consisting of three or four students working in close partnership during the practical learning. Subsequently, the groups discuss business matters, they will run subject to themes supervisory teachers developed (P₂). Furthermore, they make an analysis of market segmentation according to trends followed by customers (P₃). After knowing what products to manufacture, they continue designing products. The design created is discussed by all members of the group under the supervision of teachers. They have to choose materials, tools and the equipment needed in the production process thereafter.

The aim of the involvement of students in the planning process is not only to encourage students to explore their creative ideas and transform them into product designs, but also to help them have commitment to the teamwork and competitive spirit against any other groups shown by their level of motivation. These are all aimed at developing the creativity they will need to be entrepreneurs in the future [7-10].

The ready-made plans are later implemented through three steps (I₁-I₃), through which all group members have to manufacture selling goods as planned. I₁ is the preparatory process in which all raw industrial materials are gathered. I₂ is the manufacturing process. I₃, meanwhile, is a process in which they have to impose quality control over the manufacturing process. In practice, there are many obstacles in the way of the processes, from the poor condition of devices and equipment to human errors. Such obstacles must be encountered by all group members, and herein good teamwork is needed most, so that the groups may have good products to promote. Brilliant teamwork is one of the main characteristics of future entrepreneurs [7][8][10]. Additionally, this process helps students to have responsibility and creativity in solving possibly occurring problems.

The next step will be the reflection through quality assessment in which the manufactured products must be presented before advisory teachers and any other groups. Internal assessment (R₁) is aimed at receiving constructive feedback about the products, which helps with the decision about whether the products are good enough to be marketed. If so, the group members arrange for prepublication promotion of the products (R₂) in the university or in general public, but if not, they should remanufacture the products and make them better according to the feedback received.

This assessment, in which the products will be provided with immediate feedback from potential users and customers, is carried out in order to know whether they can satisfy consumers' desires and needs as planned. R₃ is the summary of R₁ and R₂, which is usually used in the evaluation process before the products are manufactured on a massive scale. Feedback from teachers, other groups and customers prepares students to be open to any suggestion and criticism about

their works. This will also encourage them to display good sportsmanship and to be aware of their own shortcomings, to be better in the future [48].

After the products are modified as suggested by the feedback, the group members should impose quality control over the final products under the supervision of the teachers who have the authority to determine whether a product is good enough to be marketed or if it needs modifying. Products considered to be of good quality can be marketed and distributed. All the group members must be involved in the selling action, the financial income of which is divided into capital and profits. The former will be used in manufacturing products in the next practical learning process. In Figure 1, evaluation is not only done at the end of the steps, but each step is always to be evaluated. P₅ (evaluation in the planning process), I₄ (evaluation in the production process) and R₄ (evaluation in reflection process) are evaluations made in the overall learning processes by applying entrepreneurial attitudes. Considering the urgency to enhance the quality of the learning result, an evaluation of the learning process of each step must be undertaken, because it is a very important part of the learning process that can be used to improve the quality of these learning outcomes [49-50].

CONCLUSIONS

Engineering education must provide students not only with technical skills, but also with professional entrepreneurial expertise. The learning design by entrepreneurship implementation is formulated for engineering students by implementing it in the practical learning of production in engineering education. The learning design includes devising syllabi and building up financial support for the production process, making plans and implementing them, encouraging reflection, imposing quality control, stimulating the selling process, and carrying out evaluations of every process for feedback to improve the quality of products and each step of the learning processes.

The implementation of this learning design stresses student-oriented learning and intensive supervision by teachers. The support of leaders, faculty members, staff and stakeholders is instrumental in ensuring the success of this implementation programme. The involvement of all mentioned here shows strong commitment to the importance of practical learning, because it provides students with real entrepreneurial skills in the general public. This will help engineering graduates to respond to international demands that they be equipped with professional competencies, especially for being entrepreneurs. Also, they will benefit from the learning design, for they will be completely prepared both to be potential workers and to offer job opportunities to other people.

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