

The Relationship Between Entrepreneurship Competence in Engineering Educators and Engineering Pedagogy Competences

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Abstract

Developing entrepreneurial skills and attitudes has become an important goal for educators in higher education and also in teacher education. One problem in this is associated with identifying the content of the entrepreneurship competence of educators and integrating this into engineering education. The aim of this article is to identify and assess the entrepreneurship competence of engineering educators and its relationship with other competences in engineering pedagogy. The survey is based on the IGIP model of competences for engineering pedagogy, which is complemented with new dimensions of entrepreneurship competence. The results of the study indicate that educators consider themselves most entrepreneurial in their attitude toward learners and entrepreneurship. The sub-competence “support for entrepreneurial learning” correlates with all competences of engineering pedagogy and has the strongest relationship between the reflective and developmental competences among educators in engineering pedagogy.

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1. Introduction

Previous research has highlighted that higher education is a poor contributor to graduate skills, as there is a gap between the knowledge needed at work and the skills provided through formal education (Tynjälä, 2008). In the survey by Tynjälä (2008), graduates reported lower levels of competence than are required in their jobs and their assessment differed in different categories of knowledge and skills (e.g. specialist, generic, methodological) (see also Garcia-Aracil & Van der Velden, 2008). In addition, graduates often acquire academic and technical skills (e.g. engineering, info technology), but they lack job readiness skills (Heijke, Meng & Ris, 2003), such as communication and thinking skills, problem solving, co-operation and team-work skills (Moore & Morton, 2017), as well as independence, self-confidence, motivation and general intelligence (Stewart & Knowles, 2000). The results of another study indicated that productive thinking, motivation, interpersonal skills and leadership are core entrepreneurial competences that need to be developed in educational contexts (RezaeiZadeh et al., 2017). In this case the concept of entrepreneurship is broadened to cover not only enterprise creation but also individual behaviour in both business and non-business activities (Kuratko & Hodgetts, 2004).

To fulfil the goals of entrepreneurship education set up by the EU (European Commission, 2006) and focus on the development of entrepreneurial mindset and behaviour in the students emphasizes the role of teachers in the process of embedding entrepreneurial thinking and attitudes in non-entrepreneurship courses (Teerijoki & Murdock, 2014). The results of this research points out the need for further research into the goals and practices of embedded entrepreneurship education in general and the role of the personal beliefs of educators in the further development of this approach. The results of the research also suggest that greater emphasis should be placed on discussions of how teaching practices can be organized in order to support entrepreneurial thinking (Teerijoki & Murdock, 2014). From here it is assumed that the entrepreneurial teaching approach can be integrated with professional teaching practices of different subject-specific courses, which requires equipping educators with adequate competences.

Teachers are more than producers of knowledge (van Dam, Schipper & Runhaar, 2010); instead, they are expected to act as entrepreneurs themselves (Johnson, 2004). Engineering educators should not only be able to appreciate and wonder at the modern marvels of science in the business world, but they should also understand the social use of entrepreneurial skills in their day to day scientific affairs in the classroom, outside the classroom and in the society at large (Adeyemo, 2009). According to the International Society of Engineering Education (IGIP) Curricula (2018), teachers' competences in engineering pedagogy are viewed as the integration of six different dimensions of competences (e.g. pedagogical, didactic, evaluative, organizational, communicative, reflective). In short, this includes the activity-related, personality-related, and the socio-communicative components that ensure the implementation of educational programmes. Entrepreneurship competence is quite narrowly covered in this list being represented only by some categories (e.g. communication, reflection), which allows us to assume that the development of the entrepreneurial mind-set and behaviour in graduates is also narrowly represented in the learning processes within courses.

It has been acknowledged that every educator, regardless of their field, should be able to integrate entrepreneurial activities into the study process (Kuratko & Hodgetts, 2004). It appears that teachers who are more familiar with entrepreneurship and the entrepreneurship

process possessed the best prerequisites for teaching (Hytti & O'Corman, 2004). Some teachers do not see creating the capacity to set up one's own company as being a major goal of education (Barr & Tagg, 1995). In contrast, they see stimulating an enterprising person as being central to their role in education. It is important for educators to focus on personal enterprising behaviour in every subject they teach and at all levels of education (Ma, 2000). From here it can be assumed that educators have the competences that enable them to create an environment that supports entrepreneurial learning (Gibb, 2002) for their students in their study processes.

Based on an extensive literature review it has also been acknowledged that there are interdependencies between entrepreneurial competences (Mitchelmore & Rowley, 2010). The interdependencies of core entrepreneurial competencies have been studied and ranked among key stakeholders (RezaeiZadeh et al., 2017). The research results of RezaeiZadeh et al. (2017) highlight a collective consensus among students, academics and entrepreneurs that there is a need to experiment with new teaching approaches to develop specific and important productive thinking through entrepreneurial competencies (RezaeiZadeh et al., 2017). The role of the educator as a key stakeholder in the process of embedding entrepreneurial thinking and attitudes in different courses has not been systematically investigated (Teerijoki & Murdock, 2014). Furthermore, as far as the author is aware, relationships between competences in engineering pedagogy and entrepreneurship competences have not been studied in previous research to better understand how to support the integration of entrepreneurial learning into engineering curricula.

The current research will attempt to fill this research gap and aims to identify and assess the entrepreneurship competence of engineering educators and the relationship between this and competences in engineering pedagogy. The research questions are as follows:

- How is it possible to describe the entrepreneurship competence of engineering educators?
- How does the entrepreneurship competence of engineering educators relate to competences of engineering pedagogy (according to IGIP)?

The survey is based on The International Society of Engineering Education (IGIP) model of competencies for engineering pedagogy, which is complemented by the dimension of entrepreneurship competence for educators. The latter is elaborated during the current research and includes questions characterizing the educator's attitude towards entrepreneurship and learners as well as their support for the creation of an appropriate environment for entrepreneurial learning. The data is collected among engineering educators using a quantitative survey under the Estonian programme – “Systematic Development of Entrepreneurship Education at All Educational Levels” – launched by the Estonian Ministry of Education and Research and financed by the European Social Fund.

The results of the study indicated that educators consider themselves most entrepreneurial in their attitude toward learners and entrepreneurship. The sub-competence “support for entrepreneurial learning” correlates with all competences of engineering pedagogy and has the strongest relationship with the educators' reflective and developmental competence in engineering pedagogy. Considering the fact that the data is only taken from a single university and contains a small number of respondents, it is suggested that the survey be repeated among a larger sample in other universities.

This paper is presented in five sections. Next, the theoretical framework will look at the results of previous research on educator entrepreneurship competences as well as

competences in engineering pedagogy. This will be followed by the methodology and data and results. Finally, the conclusions from the results will be presented.

2. Theoretical Framework

2.1. The Characteristics of Educators' Entrepreneurship Competence

A strategic tool in the modernization of education is the development of competence-based learning and its integration into lifelong learning (OECD, 2016). At the same time, it is believed that competence-based learning prepares students better to enter the labour market (European Commission, 2016; OECD, 2016). It also defines the role of an educator in the learning process as a contributor to competence-based learning, which requires the educator to meet the relevant professional and pedagogical knowledge, skills and attitudes. Currently, the emphasis on supporting the development of an entrepreneurial mindset and behaviour in learners raised by the EU (European Commission, 2006, 2016) is focusing on the role of teachers in the process of embedding entrepreneurial thinking and attitudes in non-entrepreneurship courses (Teerijoki & Murdock, 2014). Therefore, to develop the goals and practices of embedded entrepreneurship education and support entrepreneurial thinking and other relevant competences in learners also requires the educators to develop their own appropriate competences.

The scientific literature highlights a variety of definitions of competency, of which recent examples refer to specific contexts and competences in describing relevance to aspects of action. For example, competence expresses the combined patterns of knowledge, skills and attitudes that are relevant to achieving the desired results in specific contexts (Wesselink & Wals, 2011; Bartram, 2005) or competence is the ability to act now and in the future, taking responsibility for your actions (Mulder et al., 2009). Within the literature related to entrepreneurship and entrepreneurship education, for example, Gibb (2008) defines competence as "behaviours, skills and attributes applied individually and/or collectively to help individuals and organizations of all kinds, to create, cope with and enjoy change and innovation involving higher levels of uncertainty and complexity as a means of achieving personal fulfilment and organisational effectiveness. Enterprise education is the process by which these behaviours are practised and supported." Acknowledging the discussions from previous research, these definitions can also be appropriate for educators. The terms "competence" and "competencies" are used in the current article to refer to the competencies of engineering pedagogy and entrepreneurship held by educators in the field.

Considering the approaches to competence-based learning highlighted here and enhancing the development of entrepreneurial competences for graduates in business and non-business activities requires a deeper investigation of what entrepreneurship competence educators may possess. Although the author has not succeeded in finding a ready-made construct of entrepreneurship competence for engineering educators from the literature, it is possible to find suggestions from previous research about the main criteria and components that should be represented. Therefore, the broadening concept of entrepreneurship is seen to refer to the entrepreneurial behaviour of individuals of different status (e.g. employee, entrepreneur or citizen) and in different contexts. Therefore, entrepreneurship competence is no longer understood as the skills specifically needed for opening a business, but merely

psychologically oriented and social skills applicable in various situations (Peltonen, 2015). The research by Peltonen (2015) specifies that entrepreneurship competence is seen as a key competence of each individual referring to a sense of initiative involving the ability to turn ideas into action, creativity and risk-taking. The successful implementation of an entrepreneurial mind-set among graduates depends on the abilities of educators and the methods applied in their classrooms; that is, their approaches to teaching and learning (Hägg & Peltonen, 2011). Teachers should accept that the students have the freedom to set their own goals for learning. Entrepreneurial educators offer an active role to the students who are involved in the process. Therefore, teachers use different teaching methods that develop creativity, innovation and entrepreneurial behaviour in general. For example, the most applicable and effective teaching method suggested for developing entrepreneurship competencies is group work (Steiner, 1998; Kates, 2002; Yong & Lew, 2005; Sayles, 2006; Borredon et al., 2011; Turner, 2011).

According to suggestions from prior research, entrepreneurship competence comprises components that are deeply rooted in a person's background (traits, attitudes etc.) as well as those that are trainable or achieved through education (skills, knowledge and experience) (Mitchelmore & Rowley, 2010). Therefore, entrepreneurial competence in general helps the person to perform the teaching role successfully. Each educator should be able to choose how to put the methods into practice in a certain situation and context. As prior research shows, the educator adopts modern and appropriate learning methods, and works in an entrepreneurial way as an educator and encourages students in the learning process to foster positive attitudes towards entrepreneurship (Peltonen, 2015; Obschonka et al., 2010; Hägg & Peltonen, 2011).

The pedagogical challenge for educators is to create an environment for entrepreneurial learning that provides opportunities for practising and developing entrepreneurial competencies, where learning becomes a discovery process for the students, and where every passionate educator's goal is to make sure that the students adopt a deep approach to learning (Gibb, 2002; Sayles, 2006; Zubairu, 2016). It is the educator's duty to make sure that the students' learning experiences are as enjoyable and as memorable as possible. Rao (2016) found that a relationship exists between teaching style and specific motivators in the class, preferred teaching methods and classroom management techniques.

Shulman and Shulman (2004) further suggest that an accomplished educator will smoothly integrate his/her vision, motivation, understanding and practice into the teaching, and will thereby improve through active reflection. Reflection is thus the key to learning and development. Educators are like promoters and the main focus should be on their learning and reflection processes, which are an essential element in educational development. Hence, the educators' attitude towards their students is an important part of entrepreneurial competence.

Previous research has emphasized that a fundamental change in the education paradigm for science, technology, engineering, and mathematics from teacher-centred to student-centred is necessary (Jang, 2016), it is also actual in Estonia. And there is a need for educational change that is more about educating teachers than educating students (Seikkula-Leino et al., 2010; Schwartz, 2006). So the challenge for engineering educators is how to embed entrepreneurship education into the specialist curriculum and support learners in acquiring entrepreneurial competencies. New approaches to teaching are challenging educators to develop a teaching style that encourages learning by doing, exchange,

experiment, positive mistake-making, calculated risk-taking, creative problem-solving and interaction with the outside world. This means that the entrepreneurial teacher adopts a positive attitude towards entrepreneurship, works in an entrepreneurial way as a teacher and adopts modern learning paradigms (Peltonen, 2015). Based on the suggestions mentioned above, it can be summarized that the positive attitude toward entrepreneurship is an important component of entrepreneurial competence in educators on the one hand, as is the creation of a suitable learning environment as well as attitude toward learners, on the other. An entrepreneurial approach to teaching requires educators to actively integrate professional teaching practices into different subject-specific courses and develop adequate competencies.

2.2. Supporting the Development of the Competencies of Engineering Educators

Educational systems remain fundamentally based on specialist knowledge and, as such, require teachers to be adequately trained and proficient in their fields (Kereluik et al., 2013). But there is research about how embedding creativity in education is making learning more effective in all curricular areas (Henriksen, 2011). Previous research results indicate that the most important skills in engineering are: critical thinking, reading comprehension, active listening, speaking, complex problem solving, judgment and decision-making, writing, monitoring, active learning, time management, coordination, social perceptiveness, instructing, and learning strategies (Jang, 2016). Problem solving and a focus on innovation seem to be among the most desired competencies in engineering education and also in the development of entrepreneurial competencies both in educators and students (Jonassen et al., 2006; Purzer et al., 2016; Alsarheed, 2016). Educators argue that preparing students for careers in industry necessitates helping them to develop entrepreneurship-related knowledge, skills, and attitudes to complement traditional elements of engineering education such as technical problem-solving (Carpenter et al., 2011). For example, engineering educators must possess requisite entrepreneurial skills that will facilitate transactions in the classroom business climate; in addition, the teacher needs some essential entrepreneurial skills that will increase their efficiency and effectiveness in knowledge delivery (Adeyemo, 2009). But this cannot be done without pedagogical competence.

It has been indicated that when academics who teach engineering students are pedagogically competent, the student success in programmes is strongly supported (McKenna et al. (2014)). Besides pedagogical competencies, which a teacher obviously requires, different authors also consider communication, ethical/emotional, social and reflective competencies as important, while also mentioning personality traits, attitudes and beliefs (Table 1). Communication in that case involves the ability to clearly articulate oneself using all available methods (oral, written, non-verbal) including digital channels as necessary to be active and respectful to diverse audiences (Kereluik et al., 2013). An ethical awareness includes the knowledge and skills necessary for success in a culturally diverse society, such as the ability to imagine oneself in someone else's position and sense along with that individual, as well as the ability to engage in ethical decision-making (Kereluik et al., 2013). Assessing the competencies that have been outlined in previous studies (see Table 1), educators need to be highly creative, inventive and courageous, and at the same time, always tolerant, empathic, accommodating and helpful to others. All those aforementioned competencies are important in developing entrepreneurial competencies in general. Special attention should be paid to critical thinking, problem solving and creativity with innovation,

communication and collaboration (Tang & Lim, 2018). Educators also have to educate students and colleagues via close mutual cooperation, respecting and developing their personalities. The competencies of educators affect the way they teach and treat their students, as well as how they perceive their professional development.

Some authors emphasize several additional competencies like developmental (IGIP, 2018), motivational, creative and innovative (Blaškova et al., 2014), and also competencies associated with cultural and cross-disciplinary knowledge (Kereluik et al., 2013). Others think that teaching is closely related to psychological and evaluative competences, didactic skills as well as scientific and organizational (managerial) competencies (IGIP, 2018; Liakopolou, 2011). According to Seikkula-Leino et al. (2010), prior research highlights that teachers' attitudes are generally positive towards entrepreneurship education and being entrepreneurial as teachers.

Table 1. Educators/teachers competencies

Competence \ Author	IGIP	Zhu et al., 2013	Liakopolou, 2011	Blaškova et al., 2014	Kereluik et al., 2013
Pedagogical/teaching/learning competences	+	+	+	+	+
Communication skills (oral and written)	+		+	+	+
Ethical/emotional competences	+			+	+
Technological/digital competency		+		+	+
Personality traits, attitudes and beliefs			+	+	+
Reflective competences	+		+	+	
Social competences	+	+	+		

Source: Compiled by author

The International Society of Engineering Education (IGIP) has a tradition of almost 40 years of contributing to engineering education, and its members and many activists have contributed to making IGIP a leading global engineering association. More than 1,100 professionals all over the globe bear the title "IGIP International Engineering Educator". The aims of IGIP are:

- To improve teaching methods in technical subjects.
- To develop practice-oriented curricula that correspond to the needs of students and employers.
- To encourage the use of media in technical teaching.
- To integrate languages and the humanities in engineering education.
- To foster management training for engineers.
- To promote environmental awareness.
- To support the development of engineering education in developing countries.

According to IGIP, an ideal educator with a technical background should acquire the necessary competences of engineering pedagogy. These general competences of engineering pedagogy consist of two main groups: technical expertise and specific engineering pedagogical competencies. IGIP has established a prototype curriculum for engineering pedagogy, which is already used in several countries (Auer, Dobrovska & Edwards, 2011). The IGIP concept of engineering educational competencies is to be summarized as follows: Pedagogical, social, psychological and ethical competencies, didactic skills and subject

expertise, evaluative competencies, organizational/management competencies, communicative and social competencies, and reflective and development competencies. The pedagogical section consists of group-dynamics, and stimulates engaging interaction between engineering educators and students to promote creativity. Considering the abovementioned suggestions for supporting the development of competencies in engineering educators, the integration of the development of entrepreneurship competence within the competence of engineering pedagogy could be one way of contributing to the entrepreneurial teaching practice of engineering educators.

3. Research Methodology

3.1. Study Design

The study was designed to answer the research questions aiming to identify and assess the entrepreneurship competence of engineering educators and the relationship between that and their competencies in engineering pedagogy. Self-evaluation is one of the most overlooked forms of explicit evaluation. Approaches to measuring competencies have varied, depending on assumptions and predictions (Mitchelmore & Rowley, 2010). Smith and Morse (2005) use self-assessment where the respondents assess their own level of competence, or level of agreement with competence related statements. Ideally and logically, this should precede all other forms of the evaluation of teaching effectiveness.

This study is assessed the level of entrepreneurship competence in engineering educators and analysed the linkage between entrepreneurship competences in educators and their other competencies of engineering pedagogy. Due to the fact that all the individuals in the sample for this study were participating in an engineering educators training programme, there was an opportunity to reach exactly the right target group. Surpluses and deficits in competencies were measured by asking educators to evaluate themselves in terms of the competencies developed by IGIP.

A pilot survey has been carried out by implementing the Professional Competencies Self-Evaluation Questionnaire for educators. This is designed based on the IGIP model of competencies for engineering pedagogy and complemented with the dimension of entrepreneurship competence (7th section). The questionnaire is divided into seven dimensions (see also Appendix):

- Pedagogical, social, psychological and ethical competencies (13 statements)
- Didactic skills and subject expertise (14 statements)
- Evaluative competencies (6 statements)
- Organizational/Management competencies (6 statements)
- Communicative and social competencies (7 statements)
- Reflective and development competencies (9 statements)
- Entrepreneurship competencies (12 statements)

The self-assessment questionnaire includes three sections, where the first section has pedagogical, social, psychological and ethical competencies. The second section includes entrepreneurship competence and the third has personal information. The questionnaire includes 67 different statements for the assessment of the above listed competencies.

Entrepreneurship competence is a new dimension elaborated during the research and the statements are based on theoretical knowledge from previous research (e.g. Peltonen, 2015, Henriksen, 2011). The statements for assessing entrepreneurship competencies include; statements expressing the educator's attitude toward entrepreneurship, support for entrepreneurial learning and support for and attitude toward learners.

The respondents were asked to self-evaluate their pedagogical skills as well as express their opinion of what they think about their entrepreneurship competencies. A Likert type response scale was used with five response alternatives from "totally disagree" to "fully agree". The respondents could also leave a comment at the end of the analysis of each competence and assess their need for continuing education and the development of the assessed competencies.

3.2. Sample

The pilot survey was conducted in spring 2017 using an *online* survey tool. A sample of 54 engineering educators (N = 54) evaluated their competencies in the pilot survey. All of the respondents were participating in the technical teacher executive education programme at Tallinn University of Technology based on the IGIP curriculum (2008), and the assessment of their competencies was conducted before the course. All course participants completed the questionnaire. There were almost equal respondents by gender: 26 female and 28 male teachers. Two thirds of the respondents were in the early stages of their professional teaching experience (0–5 years) – 75% of the respondents had higher and 25% secondary or vocational education. The mean age of the participants was nearly 40 (SD=10,1; 22–61), but women were older (M age=41.6, SD=8.3) than men (M age=37.6, SD=11.3) (Table 2).

Table 2. Overview of the sample

	Sample		Age (mean)
	Quantity	Share %	
Gender			
Men	28	52%	37.6
Woman	26	48%	41.6
Total	54	100%	
Working experience			
Just starting	10	19%	39.9
1–5 years	26	48%	38.7
6–10 years	9	17%	39.0
11–20 years	5	9%	36.8
Over 20 years	4	7%	48.5
Total	54	100%	
Education			
Secondary education	3	5%	41.7
Vocational education	11	20%	33.6
Bachelor's degree	15	28%	38.9
Master's degree	23	43%	42.0
PhD	2	4%	43.5
Total	54	100%	

Source: Compiled by author

The characteristics of the sample shows that most of the respondents have work experience, which allows us to assume that the self-assessment of their competences is expressing the situation in engineering pedagogy in the current research case.

3.3. Data Analysis

The collected data includes the numerical answers each educator gave in response to the statements on entrepreneurship competence. To identify the content and structure of entrepreneurship competence and its sub-competences the Exploratory Factor Analysis (EFA) is used. The factorial structure was converged using six iterations. Factor loadings for each item were used to create an individual factor score for every respondent; that is, the 10 item scores for each respondent were reduced to 3 factor scores (Table 3). Three factors were labelled, which may be considered sub-competences of the entrepreneurship competence of the educators: attitude toward entrepreneurship (factor ENT1.1), support for entrepreneurial learning (factor ENT1.2), attitude toward learners (factor ENT1.3). The factors (ENT1.1, ENT1.2 and ENT1.3) had the best results in terms of reliability. According to the results of the factor analysis, two statements were excluded (“I consider it is important that learners’ entrepreneurship competence is supported through curricula and various subjects” and “I have good financial knowledge”). The total variance explained increased from 66% to 70%.

Table 3. Rotated factor matrix for entrepreneurship competence

Rotated Component Matrix ^a	Component		
	ENT1.1	ENT1.2	ENT1.3
1. I have several ideas that I could realize through the creation of my own company	0.863	0.187	0.070
2. I have thought that I could establish my own business	0.853	0.146	0.219
3. I think that I will be able to establish my own business and be able to act as an entrepreneur	0.757	0.022	0.413
4. I am an active initiator of ideas and activities	0.701	0.223	0.056
5. Applying teaching methods to support learner entrepreneurship competence	0.172	0.876	-0.022
6. I will always carry out my planned activities	0.038	0.755	0.321
7. I know how the students’ entrepreneurship competence can be supported in my subject	0.357	0.719	-0.225
8. I associate my colleagues with the realization of new ideas	0.105	0.672	0.138
9. I consider it important that learners can do well in their future life	0.183	-0.063	0.857
10. I consider it important to support learner entrepreneurship competence in every subject	0.247	0.321	0.798

Notes: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; rotation converged in 6 iterations. The values in bold are the highest factor loadings (>.60).
Source: Author’s compilation

In the analysis the average values are calculated for each respondent and each statement and sub-competence. The reliability is proven by using Cronbach's alpha (Table 4). Cronbach's alpha internal consistency aligns with the level of acceptable $0.7 \leq \alpha < 0.8$ and good $0.8 \leq \alpha < 0.9$.

Table 4. The factor structure of educators' entrepreneurship competence (ENT)

Factor	ENT statements	Sub-competence	Cronbach's α
ENT.1.1	Statements 1 – 4	Attitude toward entrepreneurship	0.86
ENT.1.2	Statements 5 – 8	Support for entrepreneurial learning	0.78
ENT.1.3	Statements 9 – 10	Attitude toward learners	0.79
ENT	All 10 statements		0.83

Source: Author's compilation

The data collected from the survey were analyzed using the Statistical Package for Social Sciences program (SPSS). Descriptive statistics were used to present the data, including statistical tables, frequency distribution tables and statistical measures. To measure the dependence of different variables, the Pearson correlation coefficient (PCC) is used. The PCC is a well-established measure of correlation, and has a range of 1 (perfect correlation) to -1 (perfect but negative correlation) with 0 denoting the absence of a relationship. A regression analysis was used for the assessment of the relationships between different dimensions of competence.

4. Results: The Relationship Between Entrepreneurship Competence in Engineering Educators and Engineering Pedagogy Competence

On the basis of self-evaluation, engineering educators consider themselves most entrepreneurial in their attitude towards learners. They are convinced that there is a need to support learners to do well in their future life, and that it is important to develop and support the entrepreneurship competences of students in various subjects (Table 5). These statements are included in the sub-competence "attitude toward learners" (factor ENT1.3). Most of the educators thought that they could establish their own business and that they are active initiators of ideas and activities ($M=3.87$). They rather agreed that they have several ideas that they could realize through the creation of their own company ($M=3.78$). Those statements are described in sub-competence "attitude toward entrepreneurship" (factor ENT1.1). Applying different teaching methods to support entrepreneurship in learners scored lower (sub-competence "support for entrepreneurial learning", factor ENT1.2, $M=3.54$) than other sub-competences. The educators' self-assessment about their financial competence was critical and much lower than all other aspects ($M=3.14$).

Table 5. Educator's assessment of entrepreneurship competences

Statements of entrepreneurship competence (ENT)	Mean	SD
I consider it important that learners can do well in their future life	4.63	0.68
I consider it is important that learners' entrepreneurship competence is supported through curricula and various subjects	4.31	0.73
I consider it is important to support learners' entrepreneurship competence in every subject	4.28	0.86
I have thought that I could establish my own business	3.87	1.30
I am an active initiator of ideas and activities	3.87	0.81
I have several ideas that I could realize through the creation of my own company	3.78	1.27
I know how the students' entrepreneurship competence can be supported in my subject	3.76	0.86
I associate my colleagues with the realization of new ideas	3.74	0.91
I think that I will be able to establish my own business and be able to act as an entrepreneur	3.61	1.25
Applying teaching methods to support learners' entrepreneurship competence	3.54	0.90
I will always carry out my planned activities	3.54	0.82
I have good financial knowledge	3.14	1.05

Source: Author's calculations

When the entrepreneurship competence (ENT) of engineering educators and the related sub-competences were analyzed in relation with all other competences of engineering pedagogy, the strongest associations were indicated between just one sub-competence "support for entrepreneurial learning" (ENT 1.2.) and the competences of engineering pedagogy (Table 6). The same sub-competence also has a strong influence on entrepreneurship competence (ENT) as a whole. Based on the sample used in this study, entrepreneurship competence (ENT) correlates with three competences of engineering pedagogy, including pedagogical, social, psychological and ethical (PSP) ($p < 0.01$), organizational/management (OM) ($p < 0.01$), and reflective and development competences ($p < 0.001$).

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Table 6. The relationships between educators' entrepreneurship competence and competences of engineering pedagogy

	ENT		ENT1.1		ENT1.2		ENT1.3	
	r	p	r	p	r	p	r	p
PSP	.272*	0.040	0.111	0.424	.463**	0.000	0.176	0.202
DS	0.139	0.347	-0.001	0.994	.340*	0.015	-0.056	0.685
EV	0.214	0.127	-0.042	0.769	.562**	0.000	0.005	0.974
OM	.288*	0.035	0.121	0.382	.504**	0.000	-0.018	0.897
CS	0.068	0.746	-0.105	0.451	.434**	0.003	-0.261	0.057
RD	.434**	0.001	0.199	0.149	.603**	0.000	0.211	0.126

Note: PSP – pedagogical, social, psychological and ethical competencies; DS – didactical skills and subject expertise; EV – evaluative competencies; OM – organizational/Management competencies; CS – communicative and social competencies; RD – reflective and development competencies; ENT – entrepreneurship and financial competencies; ENT1.1 – attitude toward entrepreneurship; ENT1.2 – support for entrepreneurial learning; ENT1.3 – attitude toward learners.

The mean difference is significant at the following level: $p < 0.05^*$, $p < 0.01^{**}$

Source: Author's calculations

In the following regression analyses, the educator entrepreneurship competence is considered as the dependent variable and competencies of engineering pedagogy as independent variables. In this regression model, the independent variables explained 68% of the variances in the sub-competence “support for entrepreneurial learning”, which was highly significant ($F = 6.409$, $p < .000$). The analysis shows a statistically significant relationship between educator support for the creation of an entrepreneurial learning environment and the reflective and development competence of engineering pedagogy. At the same time, there was no correlation between other entrepreneurship sub-competences and the competences of engineering pedagogy (Table 7).

Table 7. Regression results: Relationship between the competence “support for entrepreneurial learning” and engineering pedagogy competences

	B*	Std. Error*	Beta**	t	Sig.
ENT1.2.	-0.498	0.832		-0.599	0.553
PSP	0.306	0.281	0.188	1.089	0.282
DS	-0.340	0.230	-0.259	-1.479	0.146
EV	0.147	0.205	0.133	0.718	0.476
OM	0.326	0.214	0.258	1.520	0.135
CS	0.035	0.152	0.037	0.233	0.817
RD	0.547	0.228	0.400	2.395	0.021

Notes: see abbreviations in the previous table no 6.

* Unstandardized Coefficients; ** Standardized Coefficients; $r^2=0.461$

Source: compiled by author

To sum up, the results of the empirical study show that according to the educators’ opinions, entrepreneurship competence and its sub-competencies were assessed quite highly among educators and a connection exists between engineering educators’ entrepreneurship competence and the competencies of engineering pedagogy. The correlation between the educator sub-competence “support for entrepreneurial learning” and “reflective and development competence” implies that integrating competencies of engineering pedagogy and pedagogical innovations into teaching and seeking feedback is an important aspect in supporting the entrepreneurial behaviour of the learners in the classroom. The reflective competence of educators means that in the learning process attention is paid to self-development and making changes based on learner feedback.

5. Conclusion

Due to the purpose of the study being to identify and assess the entrepreneurship competence of engineering educators and the relationships between that and other competences of engineering pedagogy, a new dimension in the assessment of the entrepreneurship competence of educators was elaborated on the basis of a theoretical framework based on previous studies (e.g. Peltonen, 2015, Henriksen, 2011). Based on theoretical sources, the assessment of entrepreneurship competence is suggested through 10 statements, which were confirmed using factor analysis and describe educator sub-competences such as “attitude towards entrepreneurship”, “support for entrepreneurial learning” and “attitude towards

learners". Hence, the research contributes to the assessment of entrepreneurship competence in engineering educators and supports the improvement of engineering education and the development of the competencies of engineering educators.

These results express the positive opinion of educators in general in regard to different sub-competences of entrepreneurship competence and indicate that the sub-competence "attitude towards learners" received the highest score. According to the assessments of the educators, the statements characterizing their "attitude towards entrepreneurship" scored enough to put it in second place. The sub-competence "support for entrepreneurial learning" was ranked in third place. These results show that engineering educators are entrepreneurial themselves, but they still have to strengthen their attitude toward supporting the creation of an entrepreneurial learning environment for the development of the learners' entrepreneurship competencies as well as their own competencies in engineering pedagogy.

This research evaluated the relationship between educators' entrepreneurship competence and other competencies of engineering pedagogy for the first time based on the IGIP model. The analysis shows that only one sub-competence of entrepreneurship competence (i.e. "support for entrepreneurial learning") is statistically significantly related to other competencies of engineering pedagogy. The relationships of other sub-competences are not statistically significant, which may be influenced by the small sample size.

Considering the relationships between the educators' competencies of entrepreneurship and engineering pedagogy, this study shows that "reflective and development competencies" (RD) are most strongly related to educators' entrepreneurship competence. This is noteworthy because it shows that from the educators' point of view, reflection is key to learning and development, as, for instance, Shulman and Shulman (2004) have claimed. The other sub-competences of entrepreneurship competence such as "attitude toward entrepreneurship" and "attitude toward learners" were not related to the educators' competencies in engineering pedagogy. This result is supported by the research by Seikkula-Leino et al. (2010) and Schwartz (2006), who have shown that the main focus should be on the teacher's learning and reflection processes, which comprise an essential element in educational development. Alongside the research by Seikkula-Leino et al. (2010), this study confirms that teachers' attitudes towards being entrepreneurial are generally positive, as the attitudes of the engineering educators in this research indicated.

In summary, this research shows that adding the dimension of entrepreneurship competence to the IGIP model makes enhancing the development of entrepreneurial behaviour in engineering educators possible, as well as supporting the creation of environments conducive to entrepreneurial learning for students in their study processes.

In addition to recognizing the potential contributions, there is also a need to identify the limitations of this research. One such is that the study was carried out among one group of engineering educators in one university with a small sample, so the results cannot be generalized to all engineering educators. Therefore, the author suggests the study be repeated with a larger sample and in different contexts. The empirical assessment of entrepreneurship competence and its sub-competences developed in this study offers ideas that could complement and refine the statements characterizing the entrepreneurship competencies of engineering educators in different universities. In future studies, a more detailed analysis is recommended to improve the assessment of entrepreneurship competencies in order to support the development of educator competencies, to further contribute to the development of the entrepreneurial mindset and behaviour in graduates, and their success in future life.

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Appendix

Statements designed based on IGIP competencies

Variables	Indicators
PSP – (Pedagogical, social, psychological and ethical competencies)	<p>Create a positive working and learning atmosphere</p> <p>Prefer socially integrative leadership style in their teaching process</p> <p>See the students as learning partners in a relationship characterized by mutual respect</p> <p>Use group-dynamics, stimulate interaction between professor and students and also within student groups</p> <p>Use input from students and give students room for creativity</p> <p>Encourage the active contribution of students to learn</p> <p>Use the most important consequences of steps of human information processing to design their courses</p> <p>Teach students to think critically</p> <p>Support students in the development of their professional identity</p> <p>Use motivating measures in their teaching</p> <p>Stimulate “value-orientation” in the students</p> <p>Behave as a representative of his or her professional group</p> <p>In the event of conflicts ensure that all parties are treated with dignity</p>
DS – Didactical skills and subject expertise	<p>1. Use engineering pedagogy models of the teaching process for creating their own lessons</p> <p>2. Establish clear learning goals and learning outcomes relevant to them</p> <p>3. Study plan is based on a suitable didactic model</p> <p>4. Compile and structure methodically effective study materials</p> <p>5. Consider the teaching of the special student’s specifics (individual differences with prior knowledge, experiences, different learning styles, etc.)</p> <p>6. Choose study materials suitable for learning outcomes</p> <p>7. Inform students about the learning outcomes, assessment and requirements of the subject at the beginning of the course</p> <p>8. Choose the most suitable methods for teaching</p> <p>9. Use visual material illustrating teaching</p> <p>10. Use modern ICT tools in teaching</p> <p>11. Create interdisciplinary links in the learning process</p> <p>12. Integrating professional, technological and pedagogical innovations into teaching</p> <p>13. Use active learning</p> <p>14. Use e-learning to support contact learning</p>
EV – Evaluative competencies	<p>1. Create or arrange learning environments</p> <p>2. Use the time expediently</p> <p>3. Manage project design and implementation skills</p> <p>4. Have an overview of the legislation governing education</p> <p>5. Follow the principles of quality assurance in education activities</p> <p>6. Solve unforeseen situations creatively</p>
OM – Organizational/ Management competencies	<p>1. Create or arrange learning environments</p> <p>2. Use the time expediently</p> <p>3. Manage project design and implementation skills</p> <p>4. Have an overview of the legislation governing education</p> <p>5. Follow the principles of quality assurance in education activities</p> <p>6. Solve unforeseen situations creatively</p>

<p>CS – Communicative and social competencies</p>	<ol style="list-style-type: none"> 1. Work in an interdisciplinary team 2. Apply the principles of a simple understanding of teaching 3. Discuss with colleagues about different teaching principles 4. Communicate in international cooperation networks 5. Can speak effectively 6. Managing academic writing skills 7. Oral expression is very good
<p>RD – Reflective and development competencies</p>	<ol style="list-style-type: none"> 1. Integrating professional innovations into teaching 2. Integrating pedagogical innovations into teaching 3. Systematically rethink their own teaching strategies and their teaching behavior 4. Analyze and appreciate their skills and knowledge in the subject(s) of the subject(s) 5. Ask (during the teaching) feedback from students 6. Based on the feedback, making the necessary changes to the teaching 7. Appreciate feedback from colleagues 8. Set goals for self-development 9. Developing teaching philosophy
<p>ENT – Entrepreneurship and financial competencies</p>	<ol style="list-style-type: none"> 1. I have thought that I could establish my own business 2. I have several ideas that I could realize through the creation of my own company 3. I think that I will be able to establish my own business and be able to act as an entrepreneur 4. I am an active initiator of ideas and activities 5. I associate my colleagues with the realization of new ideas 6. I will always carry out my planned activities 7. I consider it important to support learners' entrepreneurship in their subject matter 8. I consider it important that learners can do well in their future life 9. I know how the students' entrepreneurship competence can be supported in my subject 10. Applying teaching methods to support learners' entrepreneurship competence 11. I consider it is important that learners' entrepreneurship competence is supported through curricula and various subjects 12. I have good financial knowledge

Source: IGIP Curriculum 2018, compiled by author