Inzinerine Ekonomika-Engineering Economics, **2015, 26(3), 333–342**

Enhancing Entrepreneurship Education in Engineering Students to Increase Their Metacognitive Abilities: Analysis of Student Self-Assessments

Hannes Ling, Urve Venesaar

Tallinn University of Technology
Akadeemia tee 3, 12618 Tallinn, Estonia
E-mail. hannesling@smail.ee, urve.venesaar@ttu.ee

crossref http://dx.doi.org/10.5755/j01.ee.26.3.5283

It has been widely accepted that in today's society outstanding professional knowledge in one's own specific discipline is no longer sufficient for a successful career. It is increasingly important to enhance more generic abilities in individuals so they can apply their knowledge in real-world environments characterized by change, complexity and uncertainty. This has been addressed by sharing the importance of the development of metacompetencies in students studying engineering, allowing them to operate effectively, fostering entrepreneurship and employability. This can be achieved through entrepreneurship education in universities focusing on increasing creativity, self-efficacy, systematic thinking, awareness of opportunities and learning to learn.
The aim of the current paper is to suggest a new approach to enhancing entrepreneurship education in engineering students through the development of their metacompetencies, with an emphasis on metacognition.
The study includes a quantitative survey the results of which have been analysed using linear statistical analysis and K-means clustering. Furthermore, the role of personal characteristics, study level and disciplines have been analysed.
The results confirm that the differences in levels of metacognition in students from different study levels and disciplines need to be considered when planning entrepreneurship courses. In addition, the study environment and motivation of students are important to consider when designing the programme for entrepreneurship courses.

Keywords: *entrepreneurship education, metacognition, enterprising and entrepreneurial learning, employability, success.*

Introduction

The role of education in fostering entrepreneurship in society lies in facilitating the emergence of new enterprises and the development of people's enterprisingness, which makes it possible to enhance success both in work and personal life. For this purpose it is necessary to enhance the level of entrepreneurship competencies in people and advance their ability to learn how to learn (EU 2009), contributing to employability and adaptability in changing and uncertain environments (Izquierdo & Deschoolmeester, 2008).

Hence, the focus of education has to be on students in universities, as they will likely have the greatest impact on the economy and society in the future. In line with that, there is a growing interest in what competencies should be developed in the higher education system (Birdthistle, 2008). With that, it is crucial to focus on the development of the abilities of students studying engineering. To operate effectively, it is essential in addition to professional skills for them to also possess entrepreneurial, social and interpersonal skills, fostering entrepreneurship competencies (Papayannakis *et al.*, 2008).

Previous research has contended that the development of competencies takes place in the interaction of metacompetencies (Cheetham & Chivers, 1998). Thus, it is necessary to develop metacompetencies in students, and this can be achieved by fostering awareness of metacognition, metaconation and meta-affection as outcomes of teaching (Kyro, 2006). However, it can be argued that the current state of research does not allow us to clearly identify these three components of meta-abilities in a person within the framework of entrepreneurship competencies. Scholars have turned their attention to the extent to which these components are perceived or an effect can be monitored through metacognition, by looking at metacognitive emotions (Davis *et al.*, 2010), or volition as part of metacognition (Efklides, 2009). There is also no instrument available for measuring the level of individual components of metacompetencies in the context of entrepreneurship education, except the instrument for measuring metacognition. Therefore, the empirical research in this article focuses on metacognition, and enhancing the success and employability of students studying engineering.

The aim of this study is to suggest a new approach to enhancing entrepreneurship education in engineering students through the development of their metacompetencies with an emphasis on metacognition. In line with that, the model of entrepreneurial and enterprising competencies, with the inclusion of metacompetencies is developed in order to understand the framework for further research. The current study will measure the level of student metacognition to address the following research question: How to enhance entrepreneurship education in engineering students to increase their metacognitive abilities?

The theoretical framework will provide an overview of different approaches to metacompetencies in terms of success in learning and employability for individuals in the labour market. More specifically, the concept of metacognition as an ability facilitating the adaptability of individuals is discussed.

In order to collect the necessary empirical data, both undergraduate and graduate engineering students have been asked to complete the *Measure of Metacognitive Awareness* (MMA) questionnaire in order to reveal the structure and level of metacognitive abilities in students. The research method utilized in this article involves a pre-test – post-test survey design, where students self-assessed the level of their metacognitive abilities before and after taking part in an entrepreneurship education programme.

The contribution this research brings is to present a research model, where metacompetencies are part of entrepreneurial and enterprising competencies, and to identify a method for enhancing entrepreneurship education in engineering students. This will then increase their metacognitive abilities, so that their entrepreneurship competencies also increase and they can become more adaptable and successful in the labour market.

Theoretical Framework. Metacompetencies in Enterprising and Entrepreneurial Learning

Enterprising individuals are widely acknowledged as key providers of wellbeing in societies. They are able to recognize different opportunities where others might not, and have the competencies facilitating success both in entrepreneurship and when facing uncertainty in other contexts.

Scholars have shared that competencies are the abilities of a person to use knowledge and to make things happen (Boyatzis, Stubbs, & Taylor, 2002). Still, enterprising individuals and entrepreneurs cannot become successful without also developing more general metacompetencies facilitating success both during self-employment and when working for someone else. It has been suggested that an individual should develop adaptability (Lo Presti, 2009) and self-awareness (Briscoe & Hall, 1999), as they allow all the other competencies to develop. Besides, increased adaptability contributes to the success of individuals in terms of employability (O'Connell, McNeely, & Hall, 2008). Scholars have also proposed that the necessary general competencies involve communication-competence, analytical competence, learning to learn, social competence, a sense of entrepreneurship and cultural awareness (Deakin Crick, 2008). With that, it has been acknowledged that metacompetencies are key competencies overarching the others (Cheetham & Chivers, 1996).

The competencies of a person can be enhanced via teaching and learning (Boyatzis *et al.,* 2002), focusing on the role of education. However, conventional, teacher-led approaches to learning (stressing theory and conceptual thinking) are contrary to the uncertainty and complexity of the real world, where only limited information is available at any given moment (Henderson & Robertson, 1999). In line with this, research findings suggest that learning is becoming extensively dependent on the initiative of the individual (Weinert *et al.,* 2011), and that the nature of learning is changing to include more personalised and enterprising elements (Rae, 2010). (Carey & Matlay, 2010) have indicated that there is a consensus among scholars about the growing pressure on higher education to become both more enterprising and entrepreneurial.

Thus, it is necessary to make a distinction between the concepts of enterprising and entrepreneurial learning. Rae (2005) has argued that while entrepreneurial learning focuses on managing ventures through recognizing and acting upon opportunities, enterprising learning is led instead by creativity, informality, curiosity and emotion. Therefore, developing an enterprising learning competency requires the person to be able to put more effort into controlling and regulating the learning to achieve the necessary results.

In line with that, scholars have identified deep and surface approaches to learning. It has been contended that the deep strategy refers to cross-referencing, imaginative and independent thinking (Warburton, 2003), or to the intention to understand and construct meaning from the content to be learned (Gijbels *et al.,* 2005). Surface learning places more emphasis on memorizing what has been learned, and focuses on memorizing and reproducing the factual content. Deep learning therefore engages more metacognition in individuals, enhancing their enterprising learning competency. Still, Pintrich and Garcia (1994) have pointed out that a person also needs to understand the conditions under which a certain strategy might be more effective, and not just assume that one strategy is *a priori* better in all circumstances. Individuals who understand how to control their own learning are also more likely to understand how to apply what they have learned.

In response to this, findings have asserted that being able to recognize and evaluate the learning of a person is important for reflecting on the thinking processes, and that making students aware of their learning can be promoted by metacognition (Bostrom & Lassen, 2006). It has been additionally confirmed that individuals who have received metacognitive instructions will obtain entrepreneurial abilities faster than those who have not (Mitchell *et al.,* 2005), and that the entrepreneurial mind-set, based on the ability of a person to be flexible, dynamic and self-regulating in a changing environment, is metacognitive by nature (Haynie *et al.,* 2010).

Model of Metacompetencies with an Emphasis on Metacognition

It has been observed that self-development, coupled with communication, creativity, analysis and problem-solving, is one of the core metacompetencies a person can possess, and this assists in developing other competencies (e.g. self-development) or enhancing competencies in any of the component categories (e.g. creativity) (Cheetham & Chivers, 1996). Scholars have also stressed that metacompetencies are required to enhance adaptability and flexibility in individuals (Brown, 2003), and that adaptability and identity are two key metacompetencies related to learning (Briscoe & Hall, 1999). Following this, in order to take maximum advantage of entrepreneurship education, a person should be equipped with a knowledge or awareness of their strengths and weaknesses in learning, leading to greater adaptability. In addition, the development of entrepreneurship competencies, together with professional knowledge and skills increases the competitiveness of students and graduates on the labour market.

However, it is crucial to be able to control and assess the progress of learning to fit the demands of the task at hand, so that the available resources are used effectively. In line with that, Kyro *et al*. (2012) suggest that learning depends on the learner's ability to manage the meta-level abilities of self-regulation.

Drawn from this, the model of entrepreneurial and enterprising competencies with the inclusion of metacompetencies in learning (Figure 1) builds upon the argument that as a model it can be further developed with appropriately focused entrepreneurship education, and that metacompetencies, involving self-development and adaptability, facilitate the meta-abilities of a person influencing his/her behaviour.

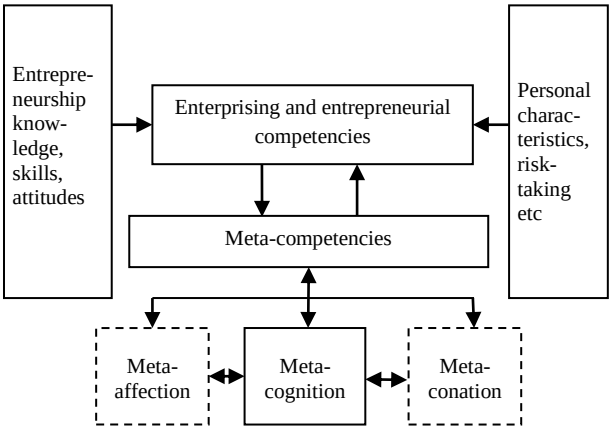

Figure 1. Model of enterprising and entrepreneurial competencies with the inclusion of the metacompetencies of a person in learning

Note: This research focuses on the metacognitive component of meta-abilities. Therefore, meta-affective and metaconative abilities are depicted using a dashed line.

Following the findings of Cheetham and Chivers (1998), the model also incorporates a feedback-loop connecting the competencies with both self-development and adaptability (i.e. metacompetencies) and the metacognitive abilities of the person. The findings of previous research, based on the tripartite model of the personality and intelligence of a person in education (Kyro, Myllari, & Seikkula-Leino, 2008), has underlined that, besides metacognition, meta-affection and metaconation also have to be fostered. Nevertheless, scholars have stressed the central role of metacognition (Ramocki, 2007), and that it can serve as an indicator of a person's metacompetency (Weinert *et al.*, 2011). Therefore, the current research focuses on metacognitive abilities in entrepreneurship education, in order to study how entrepreneurship education can contribute to the development of metacognitive abilities in students in universities.

The question is whether the content of entrepreneurship courses and teaching methods encourage the development of metacognitive abilities in engineering students? The results of student self-assessment can help to find the weakest aspects in their learning, allowing us to improve programmes and teaching methods in future courses of entrepreneurship education.

Metacognition and Metacognitive Awareness in Entrepreneurship Education

Metacognition has been referred to as 'thinking about one's own thinking' (Georghiades, 2004, p. 365). Following the research of (Haynie, 2005) in developing the concept of metacognition in an enterprising context, this study follows that there are five components of metacognition: goal orientation, metacognitive knowledge, metacognitive experiences, metacognitive choice and monitoring (or metacognitive control).

Scholars have contended that goal orientation is knowledge about what sort of goals people set when specific situations or problems arise (Efklides, 2009), or the extent to which a person interprets environmental changes in the context of different goals (Haynie & Shepherd, 2009). In line with that, metacognitive knowledge reflects the extent to which a person relies on what is already known about oneself, other people, tasks, and strategy. Metacognitive experience itself is an important resource that activates skills and controls action and behaviour (Efklides, 2009). It serves as a conduit through which memories, intuition and emotions may be employed as resources given the process of making sense of a given task (Haynie *et al.*, 2010). Put simply, metacognitive experiences allow individuals to better interpret their social world and, along with metacognitive knowledge, to inform the selection of a decision-making strategy. Furthermore, Haynie *et al.*, (*ibid.*) argue that metacognitive choice defines the decision-making strategy from an available set of options for managing a changing environment. However, they also suggest that metacognitive control allows a person to reflect on how, why and when to use certain strategies.

Thus far, the focus has been on defining metacognition and revealing its theoretical components. Still, one also has to be aware of metacognition and to be capable of using it in a systematic manner. This involves the metacognitive awareness of a person.

Schraw & Dennison, (1994) suggest that metacognitive awareness is something that allows us to plan, sequence and monitor learning so that performance is improved. Past research has also asserted that promoting metacognition begins with building an awareness that metacognition exists and increases success (Schraw, 1998), and that metacognitive awareness is connected with executing appropriate actions to achieve a particular goal (Sheorey & Mokhtari, 2001). But metacognitive awareness has also been associated with social interaction and the need to communicate thoughts to others or to understand and judge the thinking of others (Efklides, 2008). Drawing from that, students who are unaware that they lack certain abilities, factual or procedural knowledge are unlikely to make sufficient effort to acquire or construct new knowledge (Ibabe & Jauregizar, 2009).

It appears that individuals who choose to become cognitively engaged are those who are interested in the tasks they work on and in parallel see value in them. Therefore, past research has asserted that metacognition facilitates the employability of a person (Fynn, 2007; Yorke & Knight, 2004), and that individuals who reflect more actively upon their goals and know what they want to

attain, report higher levels of success (De Vos & Soens, 2008). Hence, teaching and learning methods that facilitate the success of students need to be personally engaging, and based on the active involvement of students (Watts, 2006). Therefore, increasing group work in school and integrating this with real-world experiences motivates students to engage in metacognitive, reflective thinking (Ehiyazaryan & Barraclough, 2009; Fitzgerald, 2010), enhancing confidence and success in the future.

As a result, in order for the students to be effective learners, they must adjust their efforts based on their awareness and understanding of the level of difficulty of the tasks (Isaacson & Fujita, 2006). This also requires an ability to assess the level of metacognition.

To this end, multiple instruments have been developed to capture different aspects of metacognition either in terms of the motivation to learn (Pintrich & de Groot, 1990), text comprehension (Mokhtari & Reichard, 2002), task monitoring (Tobias & Everson, 1996), knowledge regulation (O'Neil & Abedi, 1996; Schraw & Dennison, 1994), student performance (Pang, 2008) or adaptability (Haynie, 2005). Still, none of these approaches alone covers the full extent of metacognition. In this regard, the *Metacognitive Awareness Inventory* (MAI) developed by Schraw and Dennison (1994) attempts to fill this gap. Furthermore, using MAI to measure metacognition among students in learning provided Haynie (2005) with the motivation to develop a more context-independent instrument – the *Generalized Measure of Adaptive Cognition*. In order to make this instrument adapt better to the context of students with different professional and educational backgrounds, Ling *et al.,* (2013) provided the *Measure of Metacognitive Awareness* (MMA).

Therefore, the assessment measure developed makes it possible to analyse the level of metacognitive awareness and abilities, and on the basis of the information gathered, to make proposals for enhancing entrepreneurship education for engineering students.

Methodology. Study Design

For the purposes of identifying how to enhance the adaptability of engineering students through increasing their metacognitive abilities via study programmes, the students at Tallinn University of Technology, participating in courses of entrepreneurship education have been asked to complete the MMA questionnaire. Although the research involved a group of students participating in entrepreneurship courses, it is not correct to argue that only the entrepreneurship course produced an impact on student metacognitive abilities and awareness. Students have also taken part in several other courses during the semester, which are also likely to have had an impact. Nevertheless, traditional teaching methods have predominantly been used across the courses during the semester. As such, the course in entrepreneurship is considered to be the most appropriate to adopt the approach, encouraging the development of entrepreneurial and enterprising competencies. Therefore, the article focuses on enhancing student metacognitive awareness through participation in entrepreneurship education courses.

This allows us to identify if the university study programmes and in particular the entrepreneurship course has an effect on the level of metacognition in the respondents, and which statements (and respective components of metacognition) would require more attention to enhance student metacognitive awareness. For this purpose, the quantitative pre-test – post-test survey design is used, where students assessed the level of their metacognitive abilities both before and immediately after the course. The MMA questionnaire included 29 statements, divided into five components including *goal orientation*, *metacognitive knowledge*, *metacognitive experience*, *metacognitive choice* and *metacognitive control* (*monitoring)*. Respondents were asked to score each individual statement on a scale of 1 to 10, based on their own judgment where "1" is equal to *Not very much like me* and "10" is equal to *Very much like me*.

In order to identify the level of metacognition in students and the extent of the impact of entrepreneurship education on different components of metacognition among different groups of students, *k-means* clustering is applied to the student samples. This allows us to compare the effect of university courses among metacognitively high- and low-achieving students taking part in mandatory and voluntary entrepreneurship courses. In addition, it allows us to single out the weakest components (or statements) of metacognition, which need more attention when planning entrepreneurship courses to enhance student cognitive adaptability and create a basis for increasing their entrepreneurship competencies.

Sample Characteristics

The authors worked with two samples (Table 1). The first one included a dataset of 280 students from several non-economic disciplines taking part in a compulsory entrepreneurship training course over a three-year period between 2008 and 2010. The course lasted throughout the entire semester involving lectures, different practical exercises and solving teaching cases using a project-based (business planning) learning approach. This means that a more traditional approach to teaching entrepreneurship was applied (Hytti & O'Gorman, 2004).

Due to the variety of disciplines represented, the students were grouped into three categories: technical sciences (infotechnology, mechatronics, transportation technology, product development and production engineering), natural sciences (chemistry, physics, genetechnology, geology) and logistics (with business background). In addition, students from both undergraduate and graduate studies were involved. The second sample includes datasets of 79 respondents who participated in short and very intensive (i.e. 24 hours without a break) entrepreneurship training in 2009 and 2010. An action learning approach was used during these courses. The purpose of the course was to develop a business idea, and in addition, it also provided a number of discussion hours with the aim of developing creativity, innovative thinking, self-assessment skills and supporting teamwork necessary for entrepreneurial undertakings. These courses were voluntary, and so the students were more motivated to acquire entrepreneurship skills (Hytti & O'Gorman, 2004).

Table 1

Characteristics of the samples

	Count N	Male (%)	Female (%)	Total (%)
First sample	280			
undergraduate	118	51,7	48,3	100,0
graduate	162	69,1	30,9	100,0
logistics	59	61,0	39,0	100,0
tech. sciences	140	83,6	16,4	100,0
nat. sciences	81	24,7	75,3	100,0
Second sample	79			
undergraduate	74	55,4	44,6	100,0
graduate	5	80,0	20,0	100,0

Source: authors' compilation

The first sample contains more graduate than undergraduate students in different disciplines, and the second sample includes students studying mostly at the undergraduate level. Furthermore, the majority of the students in both samples were male, except for the students in the first sample who were studying natural sciences, of which the majority (75,3 %) were female.

Data Analysis

In order to answer the research question about how to enhance entrepreneurship education in engineering students to increasing their metacognitive abilities and awareness, changes in the levels of different statements of metacognition were calculated on the basis of student self-assessments. Moreover, in order to highlight the weakest components and statements of metacognition, which therefore require more attention in engineering education, we identified those groups of respondents who scored at least one statement with 1, 2 or 3 points on the 10-point scale. As a result, from the first sample, 126 respondents (i.e. 45 % of the sample) were identified before the course, and 82 respondents (i.e. 30 % of the sample) after the course, which allows us to analyse the results of their self-assessment. In a similar manner the weak components have also been identified in the students in the second sample. Thus, 35 respondents (44, % of the sample) before the course, and 21 respondents (i.e. 27 % of the sample) after the course were identified. Looking at the type of study programme (i.e. compulsory, traditional project-based, and voluntary training, involving more of the action learning approach) it is possible to indicate the effect on the motivation to study and the influence on the results of learning. The aim of the analysis was to observe students more closely in order to identify groups with different backgrounds and with different levels of metacognitive awareness. It was assumed that the present characteristics of such groups would allow us to offer recommendations so the design of entrepreneurship courses could better fit the needs of different students.

For the purpose of defining the abovementioned groups of students, clustering was carried out using the k-*means* method, which is a combinatorial data analysis method utilizing a partitional clustering approach. The objective is to maximize intra-cluster similarity and minimize inter-cluster similarity between data points. Consequently, each respondent has been assigned to a group of similar students based on the scores given to individual statements.

Results. Metacognitive Abilities of Students with Different Characteristics

Looking at the findings from student self-assessed scores in terms of magnitude of impact, it is evident that individual components of metacognitive abilities have been influenced differently by the course programmes. Furthermore, the results indicate that there are significant differences in how the effect of the entrepreneurship course is perceived among metacognitively high- and low-achieving students (Table 2). The level of metacognitive abilities in the two groups (i.e. high- and low- achievers) became significantly closer to each other after the entrepreneurship training. Hence, it can be assumed that the thinking and self-regulatory ability in low-achieving students has become more comparable to high-achieving students.

Table 2

Difference between metacognitive awareness in high- and low-achieving students according to components of metacognition (% on the measurement scale of 0…100)

	Goal Orien-tation	MC know-ledge	MC expe-rience	MC choice	Moni-toring
First sample					
before	29,8	27,2	22,5	22,2	18,9
after	18,1	16,9	13,3	13,8	11,8
difference	11,7	10,4	9,2	8,4	7,1
Second sample					
before	20,0	19,8	16,5	21,6	14,8
after	8,5	4,6	7,1	9,6	4,2
difference	11,5	15,2	9,4	12,0	10,6

Source: authors' compilation

For example the difference between these groups in terms of goal-setting skills (i.e. the goal orientation component) has decreased by more than 11 % after the training course in both samples. Aside from the fact that the magnitude of these changes is among the greatest, this indicates that related skills have, indeed, been the focus of educators in terms of teaching for many years and scholars have identified goal-setting as one of the critical abilities for everyone. Thus, it has been assumed that the ability to set goals and systematically take steps to achieve them has developed relatively more than some other components of metacognition.

In addition to goal orientation, abilities related to making new information more understandable (i.e. metacognitive knowledge) has also changed considerably (difference decreasing by 10,4 % and 15,2 % in the samples respectively). Nevertheless, it is evident that the abilities of the students to identify different routes to achieving goals (i.e. metacognitive choice) and to monitor when the goal has been achieved (i.e. monitoring) in the first sample have changed less (8,4 % and 7,1 % respectively) as a result of the learning processes during the course compared to other components. The differences among the high- and low-achievers in the second sample, however, have decreased more (12,0 % and 10,6 % respectively). Still, the fact that self-monitoring abilities have been affected less by the entrepreneurship course suggests that the students might not consider them as important as the other abilities.

Until now the focus of this analysis has been on uncovering the differences in the metacognitive abilities of high- and low-achieving students. Still, in an attempt to explain these differences, it is equally important to look at which components of metacognitive abilities have on average been scored higher or lower on the measurement scale (Table 3).

It is evident that low-achieving students gauge the level of their metacognitive abilities significantly lower before the course compared to high-achieving students. For example, among the students taking part in the mandatory course (first sample), the goal orientation component was only assessed at the level of 55,8 % on the measurement scale by the low-achievers. Similarly, metacognitive knowledge scored the lowest at only 54,9 % at the beginning of the course. While the monitoring and metacognitive choice components scored higher (65,3 % and 60,7 %), these are still at a moderate level before the course. A similar trend is visible among the students in the second sample. Therefore, the training has the potential to contribute significantly to the development of metacognition in low-achieving students.

Table 3

Average scores for student metacognitive awareness before the course (% on a scale of 0–100)

	Goal Orien-tation	MC know-ledge	MC expe-rience	MC choice	Moni-toring
First sample					
low-achievers	55,8	54,9	57,9	60,7	65,3
high-achievers	85,6	82,1	80,4	82,9	84,2
Second sample					
low-achievers	58,9	56,3	59,7	54,7	63,6
high-achievers	79,0	76,0	76,3	76,3	78,4

Source: authors' compilation

However, when looking at the assessments of the metacognitively high-achieving students, as expected, the assessments are significantly higher before the entrepreneurship courses. In addition, the high-achievers in the first sample gave their metacognitive abilities higher scores than those in the second sample.

Previous research has shown that high- and low-achievers have properties that make them different from each other (Ling *et al.*, 2013). Therefore, the various groups of students should be approached differently during entrepreneurship training in order to fully benefit from the courses.

Enhancing Entrepreneurship Education by Identifying the Weakest Aspects of Student Metacognition

After identifying and describing the different groups of students, the focus should now turn towards individual statements that scored the lowest before the training. This allows us to point out aspects needing more attention in the entrepreneurship courses (Table 4).

Based on the students in this subset, the levels of metacognitive abilities have mostly improved in all the components. Although metacognitive experiences are not listed, this does not mean that nothing needs improving regarding the students' abilities to utilize past experiences to organise information or decide what is most important to select. The deficiencies here were simply reported by a relatively smaller group of students compared to the others.

Table 4

Percentage of students with weakest aspects of metacognitive abilities from both samples before and after the course (% of both samples)

	First sample		Second sample	
	Before	After	Before	After
	N=126	N=82	N=35	N=21
Goal orientation				
A	4,3	1,8	11,4	2,5
B	7,9	6,1	6,3	
Metacognitive knowledge				
C	8,2	2,9	11,4	3,8
D	10,4	2,5	10,1	
E	7,5	3,9	7,6	
F	12,9	6,8	16,5	7,6
Metacognitive choice				
G	6,4	4,3	6,3	6,3
H	6,4	5,0	12,7	2,5
Monitoring				
K	6,8	4,6	6,3	
L	8,2	3,6	5,1	

A. I ask myself how well I've accomplished my goals once I've finished
B. I organise my time to best accomplish my goals
C. I challenge my own assumptions about a task before I begin
D. I ask myself questions about the task before I begin
E. I try to break problems down into smaller components
F. I ask myself if I have learned as much as I could have after I finish the task
G. I ask myself if there was an easier way to do things after I finish a task
H. I ask myself if I have considered all the options after I solve a problem
K. I find myself analysing the usefulness of a given strategy while engaged in a given task
L. I find myself pausing regularly to check my comprehension of the problem at hand

Note: only the largest shares have been shown
Source: author's compilation based on survey results

Looking at the data, it can be seen that some of the statements represent abilities which are problematic for all the students. For example, aspect F (*I ask myself if I have learned as much as I could have after I finish the task*), which relates to the ability to learn from completed tasks appears to remain problematic even after the courses in both samples. Still, the fact that the amount of students assessing this statement lower significantly decreased after the training (from 12,9 % to 6,8 % in the first sample, and from 16,5 % to 7,6 % in the second one) suggests that students are more aware about how retrospective monitoring helps in learning. Therefore, study-motivation might also be improved in the students. However, it can also be that students are in the habit of or are more accustomed to simply going through their studies and graduating instead of actually learning how to enhance their knowledge and skills.

Still, weaknesses in retrospective self-assessment skills in both samples become evident when looking at aspects K (*I find myself analysing the usefulness of a given strategy while engaged in a given task*) and L (*I find myself pausing*

regularly to check my comprehension of the problem at hand). The fact that there are deficiencies in relation to reviewing the chosen strategies or making sure that the task has been fully understood implies that the students are lacking crucial problem-solving skills. In line with that, the weaknesses in their thinking are also evident in terms of choosing the best way to solve a problem (*I ask myself if there was an easier way to do things after I finish a task*, aspect G), and asking themselves if everything has been taken into account (*I ask myself if I have considered all the options after I solve a problem*, aspect H) to achieve a better performance. The deficiencies in the latter also imply that students might not have sufficient need to completely solve some tasks.

Looking in parallel at aspect C (*I challenge my own assumptions about a task before I begin*) involving their ability to question their own assumptions before beginning a task, it seems that students do not sufficiently value the importance of identifying their strengths and weaknesses in learning (before the course 8,2 % of students from the first sample and 11,4 % from the second rated this low). This, in itself, might indicate that students have adopted a more superficial approach towards solving tasks during their studies, aiming to complete only what has been asked of them. Nevertheless, the weaknesses in questioning themselves about their understanding of a task (*I ask myself questions about the task before I begin*, aspect D) also suggests students have not been provided the necessary experience during earlier studies. In this case, the individual has not developed the analysis-skills essential for understanding the context and requirements of tasks. This is supported by looking at aspect E (*I try to break problems down into smaller components*), which involves metacognitive knowledge in terms of the ability to disassemble problems into smaller tasks and obtain a deep understanding of the problem.

The results also show that there is a surprising deficiency related to time-management (*I organise my time to best accomplish my goals*, aspect B), which should be an ability utilized by everyone engaged in any task. Therefore, the students might need additional training on planning the steps to achieve their goals and purposefully solve problems. The fact that this aspect is weaker among the students in the first sample could result from using traditional teaching methods that involve lectures and both theoretical and impractical tasks. The analysis of the weakest statements among the metacognitive components reveal a lack in terms of strategy and environment for teaching entrepreneurship to increase student metacognitive abilities and success in learning.

In order to reveal the effect of entrepreneurship courses in more detail, it is also interesting to look at the differences between the same weakest statements in terms of study level and gender (Table 5).

Therefore, asking themselves questions after finishing a task to make sure what has been learned (aspect F) is not common among both undergraduate and graduate students. Up to 12,7 % of undergraduates and 13,0 % of graduates reported this being the weakest before the course, involving 11,6 % of males and 15,0 % of females. Despite this, it does not indicate that male students have developed self-assessment abilities more than females. Instead, males might simply be less aware of their weaknesses, and are therefore less able to identify them.

Table 5

Differences between weakest aspects in terms of study level and gender (% of samples before/after the course)

	Under-graduate	Graduate	Male	Female
First sample				
A	4,2/,8	4,3/2,5	2,3/1,7	7,5/1,9
B	9,3/2,5	6,8/8,6	8,7/7,5	6,5/3,7
C	6,8/,8	9,3/4,3	10,4/4,0	4,7/,9
D	12,7/2,5	8,6/2,5	9,8/2,9	11,2/1,9
E	8,5/2,5	6,8/4,9	8,7/3,5	5,6/4,7
F	12,7/8,5	13,0/5,6	11,6/6,4	15,0/7,5
G	6,8/5,1	6,2/3,7	2,9/2,9	12,1/6,5
H	7,6/5,9	5,6/4,3	4,6/4,6	9,3/5,6
K	7,6/3,4	6,2/5,6	6,9/5,8	6,5/2,8
L	8,5/2,5	8,0/4,3	9,2/4,0	6,5/2,8
Second sample				
A	12,2/2,7	na	8,9/na	14,7/5,9
B	6,8/na	na	4,4/na	8,8/na
C	12,2/4,1	na	6,7/4,4	17,6/2,9
D	10,8/na	na	11,1/na	8,8/na
E	8,1/na	na	11,1/na	2,9/na
F	17,6/8,1	na	15,6/8,9	17,6/5,9
G	6,8/6,8	na	6.7/6.7	5,9/5,9
H	13,5/2,7	na	11,1/4,4	14,7/na
K	6,8/na	na	4,4/na	8,8/na
L	5,4/na	na	4,4/na	5,9/na

Note: The identifiers of individual statements refer to the ones used in the previous table; "na" refers to not available
Source: author's compilation based on survey results

Asking questions before beginning a task (aspect D) was reported weakest in the first sample more among undergraduates (12,7 %) than graduates (8,6 %) before the course. It seems that when students begin their graduate studies, they are far more aware of the significance and value of understanding the task in terms of better performance. Still, there is a significant difference between female and male students in terms of the ability to monitor their progress (*I ask myself how well I've accomplished my goals once I've finished*, aspect A). In the first sample, before the course up to 7,5 % of females reported this aspect as weak, compared to 2,3 % among male students.

At the same time, male students from the first sample have not reported any change during the course in terms of whether a chosen strategy is the best one *(I ask myself if there was an easier way to do things after I finish a task*, aspect G) or if all the options have been accounted for during problem-solving (*I ask myself if I have considered all the options after I solve a problem*, aspect H).

In terms of the second sample, considering that almost all the students were undergraduates, it is not surprising that the small amount of graduate students do not have sufficient weight to appear in this table.

The results of the analysis have shown that the level of metacognitive awareness in students and its components in the samples varies greatly depending on the group of students. Hence, the results should be taken into account for the development of entrepreneurship courses and improving the performance of students.

Conclusion & Discussion

Based on the paper's aim and the theoretical framework, the research model of entrepreneurial and enterprising competencies with the inclusion of metacompetencies has been developed to understand the framework for further research. With that, this research focuses more on metacognition as a competence to assist both in increasing performance in learning and building a successful professional career in the future.

Empirical findings among the two samples show that the levels of metacognitive abilities are perceived significantly differently between groups of students in terms of study level, gender and high- and low-achievers. In addition, the study helped identify those statements assessed as weakest. Based on the analysis of the weakest aspects of metacognitive abilities, it is evident that a significant amount of students do not invest enough effort and energy in developing their knowledge and skills. Furthermore, goal-setting skills, using existing knowledge in solving current tasks, choosing the most appropriate strategies and monitoring progress during this process should be improved. It appears that students lack general analytical problem-solving skills to facilitate success when facing novel tasks. With that, the students also consider the skills for planning their actions in advance, as insignificant or unimportant. Finally, the findings of this research reveal that the respondents might have only a limited knowledge of how to assess their actions and why. Hence, the need to achieve and to purposefully act in order to realize their abilities can be improved.

In the context of entrepreneurship education, such results can be affected by the traditional teaching methods applied in the majority of courses at university – the result of such teaching and learning being excessively based on memorizing facts (i.e. a superficial learning approach). Therefore, abilities that foster creative and independent (deep) learning, and focus on the meaning of the content are not sufficiently developed.

It would be useful to give students more practical examples about the usefulness of self-analysis. Tasks which require students to incorporate elements of previous tasks direct them to analyse the usefulness of the available information. This facilitates critical information assessment skills and would help students improve their understanding of the context and requirements of tasks.

In addition, the environment and approach for teaching entrepreneurship and enterprising behaviour should provide more real-life hands-on experience with practicing entrepreneurs. Besides focusing on lectures and theoretical and impractical tasks (traditional teaching approach), teaching methods need to include elements of action learning. This would allow the students to gather the skills needed to independently solve practical tasks, manage their time, and improve team-working skills. Furthermore, active learning is likely to contribute to self-management and adaptability as necessary metacompetencies in every enterprising individual.

As a result, the students will develop self-regulation and metacognition, which illustrates that individuals with higher levels of metacognitive abilities do not necessarily work longer or harder but instead use available resources more effectively. This means that students should be taught the skills they need to evaluate their own strengths and weaknesses.

Following this, and using the teaching methodology and approach to successful learning described here, self-assessment of student abilities provides the basis for how to design entrepreneurship education.

Research Limitations and Future Research

The limitations of this research most importantly include the fact that this measurement instrument has been used for the first time in the university context. While in general the findings are in line with the results of previous research retrieved using other instruments, it is still necessary to be aware of which results the same instrument can provide in other universities. Consequently, it is necessary to apply the MMA measurement instrument in a more diverse and larger sample of students. With that, it is the belief of the authors that new, prospective and interesting research-paths can be explored in the future to enhance entrepreneurship education for engineering students. The development of metacompetencies, including metacognitive, meta-affective and metaconative abilities according to the model presented in the article, will increase student confidence and success in the labour market, and promote the ability to adapt to changing and uncertain environments.

References

Birdthistle, N. (2008). An examination of tertiary students' desire to found an enterprise. *Education + Training, 50*(7), 552–567. doi:10.1108/00400910810909027

Bostrom, L., & Lassen, L. M. (2006). Unraveling learning, learning styles, learning strategies and meta-cognition. *Education + Training, 48*(2/3), 178–189. doi:10.1108/00400910610651809

Boyatzis, R. E., Stubbs, E. C., & Taylor, S. N. (2002). Learning Cognitive and Emotional Intelligence Competencies Through Graduate Management Education. *Academy of Management Learning & Education, 1*(2), 150–162. doi:10.5465/AMLE.2002.8509345

Briscoe, J. P., & Hall, D. T. (1999). Grooming and Picking Leaders Using Competency Frameworks: Do They Work? An Alternative Approach and New Guidelines for Practice. *Organizational Dynamics, 28*(1), 37–52. http://dx.doi.org/10.1016/S0090-2616(00)80015-7

Brown, P. (2003). Seeking success through strategic management development. *Journal of European Industrial Training, 27*(6), 292–303. doi:10.1108/03090590310479929

Carey, C., & Matlay, H. (2010). Creative disciplines education: a model for assessing ideas in entrepreneurship education? *Education + Training*, *52*(8/9), 694–709. doi:10.1108/00400911011088999

Cheetham, G., & Chivers, G. (1996). Towards a holistic model of professional competence. *Journal of European Industrial Training*, *20*(5), 20–30. http://dx.doi.org/10.1108/03090599610119692

Cheetham, G., & Chivers, G. (1998). The reflective (and competent) practitioner: a model of professional competence which seeks to harmonise the reflective practitioner and competence-based approaches. *Journal of European Industrial Training*, *22*(7), 267–276. http://dx.doi.org/10.1108/03090599810230678

Davis, E. L., Levine, L. J., Lench, H. C., & Quas, J. A. (2010). Metacognitive Emotion Regulation: Children's Awareness That Changing Thoughts and Goals Can Alleviate Negative Emotions. *Emotion*, *10*(4), 498–510. doi:10.1037/a0018428

De Vos, A., & Soens, N. (2008). Protean attitude and career success: The mediating role of self-management. *Journal of Vocational Behavior*, *73*(3), 449–456. doi:10.1016/j.jvb.2008.08.007

Deakin Crick, R. (2008). Key Competencies for Education in a European Context: narratives of accountability or care. *European Educational Research Journal*, *7*(3), 311–318. http://dx.doi.org/10.2304/eerj.2008.7.3.311

Efklides, A. (2008). Metacognition. Defining Its Facets and Levels of Functioning in Relation to Self-Regulation and Co-regulation. *European Psychologist*, *13*(4), 277–287. doi:10.1027/1016-9040.13.4.277

Efklides, A. (2009). The role of metacognitive experiences in the learning process. *Psicothema*, *21*(1), 76–82.

Ehiyazaryan, E., & Barraclough, N. (2009). Enhancing employability: integrating real world experience in the curriculum. *Education + Training*, *51*(4), 292–308. doi:10.1108/00400910910964575

EU. (2009). Notices from European Union institutions and bodies. Council conclusions on a strategic framework for European cooperation in education and training. *Official Journal of the European Union*, 2–10.

Fitzgerald, P. (2010). Enhancing employability in a final-year undergraduate module using groupwork and peer assessment. *Assessment, Teaching and Learning Journal*, *Winter*, 1–4.

Fynn, P. (2007). Developing and Assessing Graduate Employability Through Metacognition. In J. S. Chen, T. Gherissi-Labben, & A. Mungall (Eds.), *Proceedings of the First Hospitality and Leisure: Business Advances and Applied Research Conference* (pp. 228–232). July 5–6, Lausanne, Switzerland. Retrieved from http://www.i-chlar.com/Proceedings .pdf#page=228

Georghiades, P. (2004). From the general to the situated: three decades of metacognition. *International Journal of Science Education*, *26*(3), 365–383. doi:10.1080/0950069032000119401

Gijbels, D., Van de Watering, G., Dochy, F., & Van den Bossche, P. (2005). The relationship between students' approaches to learning and the assessment of learning outcomes. *European Journal of Psychology of Education*, *XX*(4), 327–341. http://dx.doi.org/10.1007/BF03173560

Haynie, M. J. (2005). *Cognitive Adaptability: The Role of Metacognition and Feedback in Entrepreneurial Decision Policies*. University of Colorado, Department of Management. http://dx.doi.org/10.1111/j.1540-6520.2009.00322.x

Haynie, M. J., & Shepherd, D. A. (2009). A Measure of Adaptive Cognition for Entrepreneurship Research. *Entrepreneurship Theory and Practice*, *33*(3), 695–714.

Haynie, M. J., Shepherd, D., Mosakowski, E., & Earley, P. C. (2010). A situated metacognitive model of the entrepreneurial mindset. *Journal of Business Venturing*, *25*(2), 217–229. doi:10.1016/j.jbusvent.2008.10.001

Henderson, R., & Robertson, M. (1999). Who wants to be an entrepreneur ? Young adult attitudes to entrepreneurship as a career. *Education + Training*, *41*(5), 236–245. http://dx.doi.org/10.1108/00400919910279973

Hytti, U., & O'Gorman, C. (2004). What is "enterprise education"? An analysis of the objectives and methods of enterprise education programmes in four European countries. *Education + Training*, *46*(1), 11–23. doi:10.1108/00400910410518188

Ibabe, I., & Jauregizar, J. (2009). Online self-assessment with feedback and metacognitive knowledge. *Higher Education*, *59*(2), 243–258. doi:10.1007/s10734-009-9245-6

Isaacson, R. M., & Fujita, F. (2006). Metacognitive Knowledge Monitoring and Self-Regulated Learning: Academic Success and Reflections on Learning. *Journal of the Scholarship of Teaching and Learning*, *6*(1), 39–55.

Izquierdo, E., & Deschoolmeester, D. (2008). What Entrepreneurial Competencies should be emphasized in Entrepreneurship and Innovation Education at the Undergraduate Level? Paper presented at conference Rencontres2008, September 1–3, St.Gallen.

Kyro, P. (2006). Teaching Metacompetences in Entrepreneurship Education. Paper presented at Second BEPART Conference, October 26–27, Tartu, Estonia.

Kyro, P., Lindh-Knuutila, T. A., Kohonen, O. K., Lagus, K. H., & Kurczewska, A. (2012). Different learning paths and profiles of entrepreneurship students. Paper presented at XXVI RENT Conference, November 22-23, Lyon, France.

Kyro, P., Myllari, J., & Seikkula-Leino, J. (2008). Kognitiiviset, affektiiviset ja konatiiviset ulottuvuudet ja niihin liittyvat metavalmiudet yrittajamaisessa oppimisessa. *Liiketaloudellinen asiakirja*, *3*, 269–296.

Ling, H., Kyro, P., & Venesaar, U. (2013). Entrepreneurship Education and Metacognitive Awareness: Development of a Tool to Measure Metacognitive Awareness. In A. Fayolle, P. Kyro, T. Mets, & U. Venesaar (Eds.), *Conceptual Richness and Methodological Diversity in Entrepreneurship Research: Entrepreneurship Research in Europe* (pp. 132–168). Edward Elgar Publishing.

Lo Presti, A. (2009). Snakes and ladders: stressing the role of meta-competencies for post-modern careers. *International Journal for Educational and Vocational Guidance*, *9*(2), 125–134. doi:10.1007/s10775-009-9157-0

Mitchell, J. R., Smith, J. B., Gustafsson, V., Davidsson, P., & Mitchell, R. K. (2005). Thinking about thinking about thinking: Exploring how Entrepreneurial Metacognition Affects Entrepreneurial Expertise. Wellesley, MA: Babson Research Conference 2005.

Mokhtari, K., & Reichard, C. A. (2002), Assessing students' metacognitive awareness of reading strategies, *Journal of Educational Psychology*, *94*(2), 249–259.O'Connell, D. J., McNeely, E., & Hall, D. T. (2008). Unpacking Personal Adaptability at Work. *Journal of Leadership & Organizational Studies*, *14*(3), 248–259.

O'Connell, D. J., McNeely, E., & Hall, D. T. (2008). Unpacking Personal Adaptability at Work. *Journal of Leadership & Organizational Studies*, *14*(3), 248–259.

O'Neil, H. F., & Abedi, J. (1996), Reliability and Validity of a State Metacognitive Inventory: Potential for Alternative Assessment, *CSE Technical Report no. 469*, Los Angeles: University of California. Papayannakis, L., Kastelli, I., Damigos, D., & Mavrotas, G. (2008). Fostering entrepreneurship education in engineering curricula in Greece. Experience and challenges for a Technical University. *European Journal of Engineering Education*, *33*(2), 199–210. doi:10.1080/03043790801980086

Pang, K. (2008). *The Metacognitive Expertise Assessment Tool: A Predictive Scale for Academic Achievement Across Disciplines*. Doctoral dissertation. Texas A&M University-Commerce, Faculty of the Graduate School.

Papayannakis, L., Kastelli, I., Damigos, D., & Mavrotas, G. (2008). Fostering entrepreneurship education in engineering curricula in Greece. Experience and challenges for a Technical University. *European Journal of Engineering Education*, *33*(2), 199–210. doi:10.1080/03043790801980086

Pintrich, P. R., & de Groot, E. V. (1990), Motivational and self- regulated learn-ing components of classroom academic performance, *Journal of Educational Psychology*, *82*(1), 33–40.

Pintrich, P. R., & Garcia, T. (1994). Self-Regulated Learning in College Students: Knowledge, Strategies, and Motivation. In P. R. Pintrich, D. R. Brown, & C. E. Weinstein (Eds.), *Student Motivation, Cognition, and Learning. Essays in Honor of Wilbert J. McKeachie* (1st ed., pp. 113–134). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rae, D. (2005). Entrepreneurial learning: a narrative-based conceptual model. *Journal of Small Business and Enterprise Development*, *12*(3), 323–335. doi:10.1108/14626000510612259

Rae, D. (2010). Universities and enterprise education: responding to the challenges of the new era. *Journal of Small Business and Enterprise Development*, *17*(4), 591–606. doi:10.1108/14626001011088741

Ramocki, S. P. (2007). Metacognition and Transfer: Keys to Improving Marketing Education. *Journal of Marketing Education*, *29*(1), 18–24. doi:10.1177/0273475306291469

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science*, *26*(1-2), 113–125.

Schraw, G., & Dennison, R. S. (1994). Assessing Metacognitive Awareness. *Contemporary Educational Psychology*, *19*(4), 460–475.

Sheorey, R., & Mokhtari, K. (2001). Differences in the metacognitive awareness of reading strategies among native and non-native readers. *System*, *29*, 431–449.

Tobias, S., & Everson, H. T. (1996), Assessing Metacognitive Knowledge Monitoring, *Collage Board Report no. 96–01*, New York: The College Board.Warburton, K. (2003). Deep learning and education for sustainability. *International Journal of Sustainability in Higher Education*, *4*(1), 44–56. doi:10.1108/14676370310455332

Warburton, K. (2003). Deep learning and education for sustainability. *International Journal of Sustainability in Higher Education*, *4*(1), 44–56. doi:10.1108/14676370310455332

Watts, A. G. (2006). Career development learning and employability. Published by The Higher Education Academy in Learning and employability, Series Two.

Weinert, S., Artelt, C., Prenzel, M., Senkbeil, M., Ehmke, T., & Carstensen, C. H. (2011). Development of competencies across the life span. *Zeitschrift für Erziehungswissenschaft*, *14*(S2), 67–86. doi:10.1007/s11618-011-0182-7

Yorke, M., & Knight, P. T. (2004). Embedding employability into the curriculum. In M. Yorke (Ed.), *Learning and Employability* (Vol. Series 3, pp. 1–28). York, UK: Learning and Teaching Support Network (LTSN). Retrieved from http://qualityresearchinternational.com/esecttools/esectpubs/Embedding employability into the curriculum.pdf

The article has been reviewed.

Received in September, 2013; accepted in June, 2015.