

THESIS ON ECONOMICS H34

**Developing an Assessment Measure for
Enhancing Entrepreneurship Education through a
Metacognitive Approach**

HANNES LING

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Dissertation was accepted for the defense of the degree of Doctor of Philosophy in Economics on 18 September 2013.

Supervisor: Professor Urve Venesaar
Tallinn School of Economics and Business Administration
Tallinn University of Technology, Estonia

Co-supervisor: Professor Paula Kyrö
School of Business
Aalto University, Finland

Opponents: Professor Petri Nokelainen
School of Education
University of Tampere, Finland

Professor Em. Kari E. Nurmi
University of Lapland, Finland
Docent, University of Helsinki, Finland

Defence of the thesis: 26 November 2013

Declaration:

Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any academic degree.

/Hannes Ling/



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ISSN 1406-4782
ISBN 978-9949-23-558-2 (publication)
ISBN 978-9949-23-559-9 (PDF)

MAJANDUS H34

**Hindamismeetodi arendamine
ettevõtlusõppe taseme tõstmiseks
metakognitiivsete võimete
täiustamise kaudu**

HANNES LING

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List of Publications

1. Venesaar, U., Ling, H., & Voolaid, K. (2011). Evaluation of the Entrepreneurship Education Programme in University: A New Approach. *The Amfiteatru Economic Journal*, XIII(30), 377-391.
2. Ling, H., Kyrö, P., & Venesaar, U. (2013). Entrepreneurship Education and Metacognitive Awareness: Development of a Tool to Measure Metacognitive Awareness. In A. Fayolle, P. Kyrö, T. Mets, & U. Venesaar. (Eds.), *Conceptual Richness and Methodological Diversity in Entrepreneurship Research: Entrepreneurship Research in Europe* (pp. 95-116). Cheltenham, UK: Edward Elgar Publishing.
3. Ling, H. (2013). Impact of Entrepreneurship Education on Students' Metacognitive Awareness: Analysis Based on Students' Self-assessments. In G. Prause, U. Venesaar, & W. Kersten (Eds.), *International Business - Baltic Business Development* (pp. 265-289). Frankfurt am Main: Peter Lang GmbH.
4. Ling, H., Venesaar, U. (2014). Enhancing entrepreneurship education of engineering students for increasing their metacognitive abilities: analysis of students' self-assessments. *Engineering Economics*. (Forthcoming)

Author's contribution to the Publications

1. The author of this thesis contributed into the 1st paper by preparing the theoretical framework and by conducting the analysis of empirical datasets. This involves both applying Bayesian Dependency Modelling for constructing the dependency networks of individual variables and statistical analysis of empirical datasets.
2. The author of this thesis compiled the theoretical framework for the 2nd paper, conducted a factor analysis and applied the necessary statistical analysis on the empirical datasets in order to present a new assessment instrument (MMA), extending the set of measurement tools for metacognition.
3. The contribution made to papers 3 and 4 involved building the theoretical framework and analysing the empirical data retrieved using the MMA measurement instrument. In addition, paper 4 introduces the model of development of enterprising and entrepreneurial competencies with inclusion of metacompetencies of a person in learning.

INTRODUCTION

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. Instead, interdisciplinary skills, creative and enterprising behaviour targeted at identifying opportunities and realising them are of great significance (Hytti & O'Gorman, 2004). The ability to apply discipline-specific knowledge to real-world settings is becoming more and more important, addressing the role of critical reflection and teamwork (Crebert et al., 2004). It has also been stressed that analytical reasoning, problem solving, intellectual curiosity, capacities to identify, access and manage knowledge and information is increasingly important for developing individuals who are both employable and capable of contributing to society (Hager, Holland, & Beckett, 2002). This leads to the need to identify how to increase the number of such enterprising individuals, equipped with an appropriate set of knowledge and abilities to generate sustainable economic growth.

Scholars have addressed the importance of developing competencies – a combination of knowledge, skills and abilities in individuals (Hoffmann, 1999; Tubbs & Schulz, 2006) that contributes to coping with uncertain environments – in order to become more successful both as an entrepreneur or an enterprising employee. Furthermore, education that focuses on fostering competencies in individuals can facilitate learning in a changing environment (Izquierdo & Deschoolmeester, 2008), and education can be used to reach increased levels of entrepreneurial behaviour (Liñán et al, 2008) and entrepreneurship (Oosterbeek, Praag, & Ijsselstein, 2010) in society. Therefore, there is a growing interest in what competencies should be developed in the higher education system and the degree to which these influence or equip career choice (Birdthistle, 2008).

In line with that, policy makers have also stressed the role of education, with the European Council turning its attention to the need to enhance creativity and entrepreneurship at all educational levels (EU, 2009). They have concluded that besides advancing lifelong learning, learning to learn as a key competency also needs to be fostered in education.

While there has been an increase in the number of colleges and universities offering entrepreneurship education worldwide, scholars have argued that there is a need to move away from the conventional focus involving new venture management and business plans (Gibb, 2002). The scope of entrepreneurship education should be to raise an awareness and mindset of entrepreneurship, learning how to innovate and develop new activities, or just discovering what entrepreneurship is *about* (Fayolle, Gailly, & Lassas-Clerc, 2006). Emphasising that individuals should be able to benefit from entrepreneurship education even if they are not starting their own company immediately, acknowledges that the role of entrepreneurship education cannot be limited solely to studying for entrepreneurship. Instead, entrepreneurship education should focus on

developing the competencies necessary *for* increased awareness about opportunities (Carrier, 2005) or an understanding of the way entrepreneurs live and learn (Gibb, 2002). This follows the findings of Garavan and O’Cinneide (1994), contending that entrepreneurship education can be enhanced by studying *through* entrepreneurship (i.e. not limiting the study programmes only with skills acquirable passively in the classroom).

This thesis follows the discussion contending that in order to facilitate an enterprisingness and success in people, and to foster learning, the result of entrepreneurship education courses should be the development of enterprising and entrepreneurial competencies.

Scholars have argued that entrepreneurial competencies can be seen as the higher order ability of entrepreneurs to perform a job successfully, by encompassing personality traits, skills and knowledge (Man, Lau, & Chan, 2002), or that they are the underlying characteristics of a person resulting in new venture creation, survival, and/or growth (Izquierdo & Buyens, 2008). Thus, entrepreneurial competencies involve identifying opportunities, acting upon them and proactiveness in facing challenges. They are context-based and focused on entrepreneurship with enhancing the abilities to create and manage a company.

Enterprising competencies, while also related to starting or running a small or new business, are important not only in the narrowly defined notions of entrepreneurship, such as starting a business (Van Gelderen, 2007). They include (but are not limited to) perseverance, initiative, persuasiveness, networking, risk-taking and decision-making under conditions of uncertainty (*ibid.*). Therefore they aim to increase success in any uncertain environment by facilitating a knowledge of self, and are necessary for all people regardless of the level of their engagement with entrepreneurship or the context they operate in.

Past research has also suggested that an individual should develop metacompetencies involving adaptability and self-knowledge (Hall & Moss, 1998; Lo Presti, 2009) or self-awareness (Briscoe & Hall, 1999), allowing all the other competencies to develop. It has been acknowledged that metacompetencies are certain key competencies which overarch others (Cheetham & Chivers, 1996), and that they serve to analyse, reason and reflect upon complex issues (Bager, 2008). Scholars have similarly proposed that such metacompetencies involve communication-competence, analytical competence, learning to learn, social competence, sense of entrepreneurship and cultural awareness (Deakin Crick, 2008), and that figural (i.e. not verbal nor numerical) reasoning contributes to enhancing the level of general competencies (Weinert et al., 2011). It draws from the findings of Winterton (2002), contending that learning to learn is a vital metacompetency for developing entrepreneurship, and Jack and Anderson (1999), who share that peoples abilities to learn and skills to adapt to changing requirements contributes into their economic security.

At the same time, increasing entrepreneurial or enterprising competencies requires the ability to identify how to support individuals in developing their

individual metacompetencies through facilitating and enhancing learning metacognition, meta-affection and metaconation as outcomes of teaching (Kyrö, 2006). With that, metacognition has been commonly referred to as '*the ability to reflect upon, understand, and control one's learning*' (Schraw & Dennison, 1994) or thinking about thinking (Boström & Lassen, 2006). Metaconation, in parallel, has been explained as '*thinking about volition, the will to act, motivation*' and meta-affection as '*thinking about emotions, temperament, mood*' (Kyrö, Seikkula-Leino, & Mylläri, 2011).

Indeed, past research has stated that in order to learn effectively, people must use metacognition to control their learning processes (Wankat, 2002), and that effective engagement in metacognitive abilities is critical to enhancing learning outcomes (Schmidt & Ford, 2003). Individuals who understand how to control their own learning are also more likely to understand how to apply what they have learned. This can be achieved by fostering learning led by creativity, informality, curiosity and emotion, which is applicable both to personal and business-world problems (Draycott, Rae, & Vause, 2011). It has also been suggested that practically everything we know and have experienced or plan to incorporate in the future involves metacognition (Ramocki, 2007), and that metacognition can serve as an indicator of the metacompetency of a person (Weinert et al., 2011). In line with this, Haynie et al. (2010) have claimed entrepreneurship courses to be especially suitable for training metacognitive abilities. It has been contended that teaching and learning methods facilitating career development and success in students need to be personally engaging and based on the active involvement of the students (Watts, 2006). Such methods can include role-play, problem-based or self-directed learning. Hence, the students who are more used to controlling their learning (adopting self-regulated learning, involving metacognition) will perform better (Vrugt & Oort, 2008).

There is an interplay between metacognition and self-regulatory skills in learning (Efklides, 2008), and past research has acknowledged that metacognition (enabling to monitor current knowledge levels, planning the allocation of learning resources with optimal efficiency and evaluating the state of learning) plays an important role in self-regulated learning (Schraw, Crippen, & Hartley, 2006). Scholars have recognized that knowledge about a person's own learning, regulation, control and enhanced metacompetencies will lead to improved learning outcomes and success in the future. Ability to regulate the learning, promoting better understanding about what a person knows facilitates success in learning (Boekaerts, 1999) and better performance (Cellar et al., 2010). Furthermore, self-regulated learning as an ability to control and influence one's learning processes during planning, goal setting, strategy implementation, and monitoring progress allows individuals to transfer competencies from one learning context to another and vice versa (Barak, 2009), contributing to the effectiveness of learning.

The effectiveness of learning can be improved by actively engaging individuals in their own learning (Riggs & Gholar, 2009), facilitating not only

the construction of but also the ability to choose between different strategies depending on the circumstances. Drawn from this, there is a need to facilitate more cross-disciplinary thinking in learning in the educational context, resulting in one outcome of learning being a critical awareness best developed within an integrated framework of different disciplines requiring a person to engage in diverse thinking (Warburton, 2003). Although researchers have expressed that metacognition has wide implications for educational settings (Kleitman & Stankov, 2007), there seems to be little evidence of the concrete effects of specific instructional techniques (Sandi-Urena et al., 2011).

Scholars have argued that there is lack of research on emotion in learning (Entwistle & McCune, 2004), and that researchers should become more interested in the affective and motivational aspects of entrepreneurial processes (Baron, 2008; Hayton & Cholakova, 2011). Different attempts to conceptualize this have been built around metacognitive emotions (Davis et al., 2010), volition as part of metacognition (Efklides, 2009), or metaconation as a goal-oriented action (Riggs & Gholar, 2009). Research has also found that feelings are metacognitive in nature and metacognition facilitates self-regulation in learning, involving affective and conative processes (Efklides & Petkaki, 2005; Efklides, 2009). Drawing on the research of Schraw, this thesis follows the path of Haynie (2005), building on views that emphasize the following five incorporating components of metacognition: goal orientation, metacognitive knowledge, metacognitive experiences, metacognitive choice and monitoring (or metacognitive control). Nevertheless, some ambiguity and uncertainty still exists in regard to the knowledge about metacognition *per se* in entrepreneurship education.

The author has therefore identified a gap in existing research in relation to the need to understand how to teach students to develop metacognition in order to enhance metacompetencies in learning, employability and improve their ability to adapt to the surrounding environment. Here entrepreneurship education can make a significant contribution, as one of the goals of entrepreneurship programmes is to instil in students the learning and development of metacompetencies to enhance their preparedness for an enterprising life.

The aim of current thesis is to contribute to the development of an assessment instrument for entrepreneurship education in universities with a new approach to developing student metacompetencies that foster enterprising and entrepreneurial behaviour. Therefore, the thesis focuses on metacompetencies through metacognition and their measurement. The empirical research aims to reveal aspects of entrepreneurship education that contribute more to the development of metacognitive abilities and entrepreneurship competencies in students. The thesis is based on four independent research papers, addressing the following research tasks:

- Task1: Development of a new approach to the evaluation of entrepreneurship education in university.
- Task2: Development of a measurement instrument for capturing the level of metacognition in students.
- Task3: Assessment of the impact of entrepreneurship education on the metacognitive abilities and awareness of different groups of students.
- Task4: Enhancement of entrepreneurship education for engineering students to increase their metacognitive abilities and employability.
- Task5. Developing a model of enterprising and entrepreneurial competencies with the inclusion of metacompetencies for individuals in studies.

The aim of the first research paper (Appendix 1) is to reveal a new approach to evaluating entrepreneurship education programmes in university based on changes in student thinking processes, and to examine whether the five components of metacognition, as suggested by Haynie, are evident among the students taking part in entrepreneurship education. In addition, the author hypothesizes that the different components of the metacognitive abilities of a student are affected differently by the entrepreneurship training. Consequently, the *Generalized Measure of Adaptive Cognition* (GMAC), developed by Haynie, is tested on the students studying different non-economic disciplines. The findings, analysed using Bayesian Dependency Modelling, provide an answer to Task 1, but contribute also to Task 3.

The second research paper (Appendix 2) tests the applicability of Haynie's measurement instrument (GMAC) on the Estonian sample. The focus has been on identifying the extent to which this instrument works with students with different backgrounds and how it can be adapted for a better assessment of entrepreneurship education through changes in the metacognitive awareness of students. In this process the author shows that in order to use the GMAC instrument, it needs to be adapted to each context it is used. This provides an answer to research Task 2, and develops the modified instrument referred to as the *Measure of Metacognitive Awareness* (MMA).

The third research paper (Appendix 3) is devoted to providing empirical evidence about the impact of entrepreneurship education for enhancing metacompetencies in the teaching process in different groups of students with different characteristics (i.e. Task 4). In order to identify different groups of students (i.e. metacognitively low and high achievers), *K-Means* clustering is utilized. This allows us to compare the results of the two extreme groups, assuming that the differences between them will be better visible. Additionally, the author has utilized the MMA instrument to study which components of student metacognition require more attention in entrepreneurship training courses (Task 3).

Furthermore, in order to conceptualize the metacognitive awareness and metacompetencies of individuals, the fourth paper introduces the model and

connects the concepts with the context of learning. Based on this, the paper contributes to research Tasks 3 and 5.

The contribution this thesis brings, both theoretically and practically, lies in the following.

In terms of theory, the current research provides a new approach to assessing the impact of entrepreneurship education through the metacognitive abilities of students. In line with this, the new *Measure of Metacognitive Awareness* (MMA) assessment instrument has been developed to measure the level of metacognition in students participating in entrepreneurship courses.

In addition, the model of enterprising and entrepreneurial competencies has been developed, including the metacompetencies of individuals currently in studies. This thesis follows the scientific discussion contending that metacompetencies are a combination of metacognition, meta-affection and metaconation. Based on this, the author argues that in order to enhance the impact of entrepreneurship education, it is necessary to increase an understanding of the role of all three components in training programmes allowing the students to become more employable and successful in society.

The practical contribution concentrates on identifying the heterogeneity of students in terms of levels of metacognition, study level, study discipline and gender. Furthermore, information about the level of metacognition in students makes it possible to improve the effectiveness of entrepreneurship education by changing the thinking patterns of students to accommodate more enterprising elements. Besides, the availability of the MMA instrument broadens the set of tools measuring metacognition to facilitate adjustments to the entrepreneurship education based on the strengths and weaknesses in the thinking of individuals.

The thesis is structured in the following manner. The first section presents the theoretical framework, including the concepts of enterprising and entrepreneurial learning, meta-abilities and metacompetencies, metacognition and metacognitive awareness, the connection between metacognition, success in learning and employability, metacompetencies in entrepreneurship education and its measurement. This is followed by the second section, which describes the philosophical worldview, methodologies applied including the principles of working with literature, design of the empirical research study, the principles of data collection and analysis. In the third part of the thesis, the results of the empirical research are discussed, followed by the conclusion and list of references.

The list of the co-authored approbated publications presenting the research findings, is as follows:

- Ling, H., Venesaar, U. (2014). Enhancing entrepreneurship education of engineering students for increasing their metacognitive abilities: analysis of students' self-assessments. *Engineering Economics*. (Forthcoming)
- Ling, H. (2013). Impact of Entrepreneurship Education on Students' Metacognitive Awareness: Analysis Based on Students' Self-assessments. In G. Prause, U. Venesaar, & W. Kersten (Eds.), *International Business - Baltic Business Development* (pp. 265-289). Frankfurt am Main: Peter Lang GmbH.
- Ling, H., Kyrö, P., & Venesaar, U. (2013). Entrepreneurship Education and Metacognitive Awareness: Development of a Tool to Measure Metacognitive Awareness. In A. Fayolle, P. Kyrö, T. Mets, & U. Venesaar. (Eds.), *Conceptual Richness and Methodological Diversity in Entrepreneurship Research: Entrepreneurship Research in Europe* (pp. 95-116), Cheltenham, UK: Edward Elgar Publishing.
- Ling, H., Ustav, S., & Venesaar, U. (2012). Development of Entrepreneurship Education through Enhancing Metacognitive Awareness of Students. August 19-25, Kolding, Denmark: Paper presented at ESU Conference on Entrepreneurship.
- Ling, H., Leppiman, A., & Venesaar, U. (2011). Exploring Metalearning in Entrepreneurship Education. In G. Prause, & U. Venesaar (Eds.), *University-Business Cooperation - Tallinn 2011* (pp. 114–134). Berlin: Berliner Wissenschafts-Verlag.
- Ling, H., Liiv, I., Toding, M., & Venesaar, U. (2011). Metacognitive Awareness in the Frame of Entrepreneurial Profile of Students: A Case of Estonia. In: *Conference Proceedings of the ESU Conference on Entrepreneurship: Final Papers (CD-ROM)*, September 12-17, Seville, Spain.
- Venesaar, U., Ling, H., & Voolaid, K. (2011). Evaluation of the Entrepreneurship Education Programme in University: A New Approach. *The Amfiteatru Economic Journal*, XIII(30), 377–391.
- Pedas, K., Ling, H., & Venesaar, U. (2010). The Entrepreneurial Behaviour and Intentions of Students: A Case of Estonia. May 19-21, Kolding, Denmark: Paper presented at the 16th Nordic Conference on Small Business Research.
- Pedas, K., Ling, H., & Venesaar, U. (2010). Entrepreneurial Profile of Students and Motivations for their Career Choices. In: *Conference Proceedings of the ESU Conference on Entrepreneurship: Final Papers (CD-ROM)*, August 22-28, Tartu, Estonia.
- Ling, H., Venesaar, U., & Voolaid, K. (2009). Assessing the Results of Entrepreneurship Training through Changes in Metacognitive Awareness of Participants. September 8-13, Benevento, Italy: Paper presented at the ESU Conference on Entrepreneurship.

Acknowledgements

Doing the research described in this dissertation has been an unforgettable personal experience. I have had the privilege to meet, work and become friends with several great people from different parts of the world. This dissertation would not have been possible to write without the help, advice, guidance and support of all these people.

I would like to express my gratitude to my first supervisor, Prof. Urve Venesaar for bringing me to the subject of metacognition and entrepreneurship education. She introduced me to the leading researchers in this field, always had the time to discuss my research and never gave up on me. Thank you for suggesting an exciting research topic and providing all the opportunities to connect with and learn from the other researchers both in Estonia and abroad.

I am indebted and thankful to my co-supervisor Prof. Paula Kyrö for the deepest insights in science, belief in the research, for all her constructive criticism and most valuable comments. Thank you for the discussions we have had, and for enlightening and encouraging me in my approach to the research.

I would like to thank Prof. Jill Kickul from New York University Stern School of Business for reacting with such enthusiasm and positive energy to my first steps in scientific research. Meeting her at a conference resulted in devoting myself to study entrepreneurship further. In addition, Prof. Petri Nokelainen should be remembered for explaining the Bayesian Modelling, making it possible to conduct testing the results of assessment instrument. I am very grateful to Prof. Em. Kari E. Nurmi for taking the time to pre-examine the thesis and give such valuable comments, remarks and questions. The fellow PhD students from the ESU network with whom I have had a chance to discuss the research, should also be remembered for their fruitful suggestions for incorporation in the topic.

I would like to thank my employer for allowing me to follow a flexible working schedule during the entire period of my studies. Supporting me in this way indicates considerable confidence and commitment.

The publication of this thesis is funded by the Doctoral School of Economics and Innovation established under the auspices of the European Social Fund. I am therefore thankful to the European Social Fund and the DoRa programme for the financial support to attend conferences in order to present the research results. Many thanks also to the Doctoral School of Economics and Innovation at the University of Tartu and Tallinn University of Technology. I would like to thank Marianne Kallaste for the administrative support through all these years.

Finally, I would like to express my sincere gratitude to my family and friends for supporting my academic ambitions. Kadri and Marta, without your unending understanding this journey would have not been possible.

Tallinn,
September 2013

1. THEORETICAL FRAMEWORK

1.1. Enterprising and entrepreneurial learning competencies

Enterprising individuals are widely acknowledged as key providers of wellbeing in societies. Multiple scholars have shared the view that there is a growing demand for enterprising individuals and entrepreneurs, by arguing that entrepreneurial activity has a widespread effect on economic growth and development (e.g. Acs et al., 2008; Stel, Carree, & Thurik, 2005). Thus, enterprising individuals are able to recognize different opportunities where others might not, and have the competencies that facilitate success both in entrepreneurship and when facing uncertainty in other contexts.

Scholars have shared that competencies are abilities to use knowledge and to make things happen (Boyatzis et al., 2002). Thus, competencies are necessary for all people, allowing them to meet the demands of different tasks and reach their goals.

It has been argued that entrepreneurial competencies can be seen as the higher order ability of the entrepreneur to perform a job successfully, by encompassing personality traits, skills and knowledge (Man, Lau, & Chan, 2002). This thesis follows that entrepreneurial competencies involve both recognizing and taking advantage of opportunities, and seeing the company growth through creation to fruition (Chandler & Jansen, 1992); Izquierdo and Buyens (2008) have also suggested that the key contributors to entrepreneurial competencies are tolerance of ambiguity, locus of control, propensity to take risk, self-confidence, persistence, assertiveness, leadership, capacity for innovation, intuitive thinking and decision-making. With that, entrepreneurial competencies are context-based by focusing at least partly on entrepreneurship to enhance the abilities to create and manage a company. An entrepreneur is likely to take advantage of such an abilities. Still, non-entrepreneurs can also benefit from entrepreneurial competencies to a certain extent. Enhanced self-confidence or an ability to persist with tasks and not give up immediately when obstacles arise is useful to any person wanting to become successful. Hence, Pool and Sewell (2007) have suggested that enterprising graduates (i.e. imaginative, creative and adaptable learners) would have most of the necessary skills for a successful career, and that entrepreneurial skills are only a valuable addition for graduates who want to be engaged in entrepreneurship.

However, enterprising individuals and entrepreneurs cannot become successful without also developing enterprising competencies facilitating success not only during self-employment or when working for someone else but also under other circumstances. Enterprising competencies aimed at increasing the ability to adapt to the surrounding environment and a knowledge of the self, are needed by all the people, regardless of the level of their engagement with entrepreneurship or the context they operate in.

The findings of past research have stressed that the competencies of a person can be enhanced with teaching and learning (Boyatzis et al., 2002), addressing the role of education. Besides, education contributes to enhancing peoples performance, success and employability in a changing environment; that is, fostering enterprisingness (Yorke & Knight, 2004).

Hence, the traditional teacher-centred learning process where students perform a passive role does not prepare them for the conditions where entrepreneurs act. Entrepreneurs need to remain constantly alert to new opportunities or market segments. If, for example, student do not receive related practical experience during their studies it is possible that their readiness to be engaged in entrepreneurial activities might be lower resulting in poor performance. Henderson and Robertson (1999) have also acknowledged that conventional teacher-led approaches to learning (stressing theory and conceptual thinking) contrast with the enterprising reality where only limited information is available at any moment. Subsequently, the learning process should aim to offer students an understanding of how entrepreneurs exploit new opportunities and learn from experience. To fulfil this, learning needs to facilitate more cross-disciplinary thinking, resulting in a critical awareness best developed within an integrated framework of different disciplines (Warburton, 2003). In line with this, research findings suggest that learning is becoming both extensively dependent on the initiative of the individual (Weinert et al., 2011), and that it is changing to include more personalised, enterprising elements (Rae, 2010). In a similar manner, it has been argued that the best way to develop enterprising skills and behaviours is through adopting a teaching style that encourages problem solving and creativity (Jones & English, 2004).

Such an approach is led by creativity, informality, curiosity and emotion, while entrepreneurial learning focuses more on managing ventures through recognizing and acting upon opportunities, or allowing enterprising individuals to develop entrepreneurial knowledge (Politis, 2005). With that, enterprising learning is more likely to increase the degree of freedom of an active and engaged individual compared to one pursuing a traditional approach. Nevertheless, one of the core elements of enterprising learning is an action-oriented attitude towards a complex world (Kyrö, 2005), involving initiating goal-directed action and responding flexibly to situational demands. With developing a more proactive attitude to learning and facing problems in everyday situations, initiative and beliefs about one's own abilities also become especially important. They could be better developed and the interest of the person increased if learning tasks are sufficiently challenging and require the person to adapt different skills creatively. Therefore, there is a need to increasingly adjust education to the needs of individual learners. This is supported by findings that a person's self-esteem as well as beliefs regarding abilities and competencies play an important role in determining educational outcomes (Coutinho & Neuman, 2008; Geisler-Brenstein et al., 1996).

In order to develop the related learning competencies, a person has to be able to exert more effort to control and regulate learning to achieve the required results. Although, the development of the capacities enabling individuals to learn also implies changing education so that besides learning in schools, individuals will develop habits enabling them to continue learning throughout their adult life (Black et al., 2006).

The issue of changing the content of learning has been on the agenda for some decades (Kyrö, 2005), causing scholars to constantly search for ways to provide new pedagogical approaches to innovative and enterprising teaching and learning. With that, scholars have proposed that the effectiveness of learning can be improved by actively engaging individuals in their own learning (Riggs & Gholar, 2009), facilitating not only the construction of but also ability to choose between different strategies depending on the circumstances.

With that, deep and surface learning strategies have been identified. It has been argued that deep strategies can be more associated with cross-referencing, imaginative and independent thinking (Warburton, 2003), or intentions of individuals to understand and construct the meaning of the content to be learned (Gijbels et al., 2005). At the same time, surface learning places more emphasis on memorizing and reproducing what has been learned. Deep learning therefore engages more metacognition and self-regulation, enhancing enterprising learning competencies. Besides, teaching practices that provide more freedom to choose both content and methods of learning seem to encourage individuals to adopt a deep learning approach (Ramsden, 1997), and self-regulated deep learners (i.e. those with higher motivation to learn and to manage their learning environment), equipped with higher self-confidence also perform better (Blom & Severiens, 2008).

Nevertheless, knowledge about learning alone might not be enough to promote the achievement of increased enterprising learning; individuals also have to be motivated to use the strategies and stay alert to changes in the surrounding conditions. As noted by Pintrich and Garcia (1994), a person 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 any circumstances. Besides, individuals who understand how to control their own learning are also more likely to understand how to apply what they have learned. As a result of this, an individual will have increased abilities to cope with uncertainty, leading to greater success under real-life circumstances. This has led to a common opinion among scholars that the traditional approach to entrepreneurship education (e.g. teacher-centred passive learning in the classroom, lectures, business plans) does not satisfy today's needs because of the increasing degree of complexity in the external environment.

Consequently, the education system should shift focus from teaching to an increasingly student-oriented learning, which can be promoted by developing metacognition among students. Scholars have agreed that students can enhance their learning by becoming aware of their own thinking as they read, write and

solve problems (Mokhtari & Reichard, 2002). This is consistent with the findings of Schraw (1998), who argues for the importance of metacognition in learning, suggesting that it enables students to both manage their cognitive skills better and recognise weaknesses that could be corrected in the future.

1.2. Meta-abilities and metacompetencies

The topic of metacognition has already been the focus of entrepreneurship scholars for many years (Schraw, 1998). One of the first definitions of metacognition in entrepreneurship studies comes from Flavell (1979), describing it as a higher order cognitive process referring to organizing what individuals know and recognize about themselves, tasks, situations and their environments. He elaborated further that knowledge about metacognitive factors concerns what strategies are likely to be effective in achieving goals of different tasks. Even more, he contends that metacognition can be deliberately or unintentionally activated when engaged with a search for an effective strategy.

Metacognitive experiences instead refer to cognitive or affective experiences that accompany any intellectual action. Flavell assumes that such experiences are especially likely to occur in situations that stimulate careful, highly conscious thinking (*ibid.*). He has importantly also concluded that metacognitive knowledge and metacognitive experiences (as part of cognitive monitoring), are partially overlapping concepts, with metacognitive experiences having effects on metacognitive knowledge, and activating strategies for achieving goals.

The concept of metacognition has been further elaborated by Flavell (1987) stating that while a cognitive strategy serves to take the individual to some cognitive goal, the purpose of a metacognitive strategy is not to reach the goal, but rather to feel confident that the goal has been accomplished. This is important to consider with entrepreneurs constantly facing new, challenging or unfamiliar tasks. For example, when taking advantage of a new business-opportunity or developing a strategy for entering a new market, it might therefore not be primary to see that plans are executed to the letter, but instead to stay alert for changes in the environment and adapt initial plans accordingly. Hence, utilizing meta-abilities facilitates the confidence that the task has been accomplished to meet the demands with a configuration of resources chosen depending on the goal and external conditions.

In line with that, Schraw and Dennison (1994) established two major theoretical components of metacognition they refer to as *knowledge* about and *regulation* of cognition. Hacker (1998) in turn, divides metacognition into three types of thinking, namely, metacognitive experience – one's current cognitive or affective state, metacognitive knowledge – what one knows about knowledge, and metacognitive skill – what one is currently doing. This suggests that metacognition is influenced by the emotions and mood of a person.

Connecting with entrepreneurship, Mitchell et al. (2005) have proposed that metacognitive thinking can be deliberately practiced in an entrepreneurial context and that it leads to the creation of entrepreneurial expertise. Moreover, individuals who have received metacognitive instructions will obtain entrepreneurial abilities faster than those who have not (*ibid.*). If this is correct then the skills of managing a company are likely to be mastered in a shorter period of time when a person is able to point to weaknesses in cognitive functioning. In line with that, Haynie et al. (2010) have proposed that the entrepreneurial mindset is metacognitive by nature, and that entrepreneurship courses are especially suitable for training metacognitive abilities.

However, it is essential to argue that scholars use both the terms metacognitive skill (e.g. Cassidy, 2006; Johnson, 2006; Marshall-Mies et al., 2000; Veenman & Elshout, 1999) and metacognitive ability (e.g. Batha & Carroll, 2007; Everson & Tobias, 1998; Warburton, 2003) when discussing metacognition. Hence, the terms are not synonyms and should not be used as such.

The ability to think has been related to intelligence (Halpern, 2000: p.18), making it therefore inherent to any person. Consequently, everyone has the basic ability to think, regardless of the context or environment. However, cognitive abilities can be developed through learning and training in order to foster success under different conditions. Furthermore, meta-ability is an underlying, learned ability playing a role in the use of different knowledge and skills effectively (Watts, 2006). In line with that, Schraw and Dennison (1994) share the view that metacognition is the ability to reflect upon, understand, and control one's learning. Skills in parallel are not inherent; they require learning and context-specific training leading to development over time, and are seen as dimensions of abilities (Anthony & Armstrong, 2010). Therefore, this notion of abilities is used hereafter.

Still, competence allows people to successfully meet complex demands through the mobilisation of different abilities, and learning how to understand, adapt and flourish in the contemporary world is a critical competence, acquired in an ongoing lifelong learning process (Deakin Crick, 2008). Consequently, key competencies can be characterized as being multifunctional, transversal across social fields, referring to an active, reflective and responsible approach to life, and incorporating know-how and analytical, critical, creative and communication skills.

Scholars have underlined that metacompetencies are those which all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment (Deakin Crick, 2008), and that metacompetencies facilitate the acquisition of other competencies (Delamare Le Deist & Winterton, 2005). With that, it has been acknowledged that metacompetencies are key competencies which overarch others (Cheetham & Chivers, 1996), and that they facilitate analysing, reasoning and reflecting about complex issues (Bager, 2008). This suggests that metacompetencies are not only

a set of more general, critical competencies, but also connect with the meta-abilities of a person.

This means that in universities together with developing professional skills in students also applicability of knowledge, their motivated learning and metaknowledge (i.e. meta-abilities, metacompetencies) become important. In this context metaknowledge involves individuals awareness about his or her thinking and an ability to monitor and change this (Gavelek & Raphael, 1985). Such an awareness helps to develop ability of learning to learn and supports acquisition of other knowledge. This suggests that universities should aim to develop metacompetencies in their students. Consequently, entrepreneurship education can make a significant contribution, as one of the goals of entrepreneurship programmes is to instil in students the learning and development of metacompetencies enhancing their preparedness for an enterprising life.

1.3. Metacognition and metacognitive awareness

Taking into account the different positions of social psychologists, drawing on the research of Schraw and developing the subject in the context of enterprising learning, this research follows the example of Haynie (2005). It builds on the view that emphasizes five incorporating components of metacognition as follows: goal orientation, metacognitive knowledge, metacognitive experiences, metacognitive choice and monitoring (or metacognitive control). This thesis asserts that learning depends on the learner's ability to manage the meta-level abilities of self-regulation (Kyrö et al., 2012).

Self-regulation has been defined as the ability to develop knowledge, skills, and attitudes, which can be transferred from one context to another (Boekaerts, 1999). Increased self-regulation is crucial for the ability to monitor the effective use of available resources. Hence, within the context of lifelong learning, self-regulation has an important role in forming decisions about the content of learning (Weinert et al., 2011). With that, there is little doubt that self-regulation plays an important role in influencing performance both at school and work. Furthermore, self-regulation has been connected with goal-setting abilities (Boekaerts, Maes, & Karoly, 2005), suggesting that individuals who are aware of what their goals are and how their goal system functions are in a better position to steer and direct its behaviour.

According to Efklides (2009), goal orientation involves knowledge about what sort of goals people apply when specific situations or problems arise. As such it involves asking oneself questions about the requirements of the task, comprehension and possible contradictions and missing information that hinders understanding the task. Efklides (*ibid.*) explains further that goal orientation may also involve the establishment of sub goals and their sequencing, time-scheduling, establishing check-points for monitoring the progress of the work or

going back and forth while reading instructions. At the same time, taking into account the changing entrepreneurial environment, Haynie and Shepherd (2009) have suggested that goal orientation is the extent to which a person interprets environmental changes in the context of personal, social or organizational goals. Therefore, the context and also the motivation for an individual to pursue goals becomes very important. Indeed, as suggested by Boulay et al. (2010), motivation and metacognition are very closely interrelated. For example, looking at any entrepreneur, it would be difficult to become successful without a share of motivation despite how well a person has planned activities, considered possible scenarios or is aware of the aspects of his or her thinking. However, Boulay et al. (2010) also argue that motivation relates more to the additional positive energy someone puts into actions. Likewise, the findings of Kyrö et al. (2008) suggest that motivation is more connected with the conative rather than the cognitive component of a human personality and intelligence, suggesting it is not an inherent part of metacognition. Nevertheless, while past research has identified three components of meta-abilities, this thesis focuses on metacognition, as it is still ambiguous how to develop it within the context of entrepreneurship education.

Metacognitive knowledge reflects perceptions about oneself, and about others in terms of competencies, weaknesses, and how they think, comprehend and use memory (Flavell, 1979). Schraw and Dennison (1994) elaborated this by distinguishing in their research between declarative, procedural and conditional knowledge. They find that metacognitive knowledge is declarative in terms of including knowledge about oneself as a learner and about what factors influence one's performance. Procedural knowledge, in parallel, refers to knowledge about doing things and is conditional on knowing when and why to use declarative and procedural knowledge (Schraw, 1998). However, when, why, and what kind of strategies to use and representations of reality, can differ between people and can be wrong or inaccurate when our epistemological beliefs are set (Efklides, 2009). Besides, epistemological beliefs are crucial for the critical appraisal of thinking and reasoning. It has been shown that individuals who know about different kinds of strategies for learning, thinking and problem solving will be more likely also to use them. Therefore, metacognitive knowledge reflects the extent to which a person relies on what is already known about oneself, other people, tasks and strategy (Haynie & Shepherd, 2009).

Metacognitive experience is an important metacognitive resource providing input that activates skills, controlling action and behaviour. It consists of individual experiences that are affective, based on cognitive activity and serve as a conduit through which previous memories, intuitions, and emotions may be employed as resources given the process of making sense of a given task (Efklides 2009, Haynie et al. 2010). Haynie et al. (2010) see it is important to note that knowledge and experiences can only be characterized as metacognitive in cases when the individual has an awareness of how that knowledge or experience relates to formulating a strategy for the task at hand. As suggested by

Efklides (2008), this awareness when expanded to emotions, feelings and attitudes is a crucial part of metacognitive experience. Furthermore, metacognitive feelings like the feeling of knowing, familiarity, difficulty, confidence, and so on, serve to some extent as indicators of learning. 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. Still, it can be too limiting to look at individuals' past experiences from the metacognitive perspective alone. Past experiences and the ability to use them in the future can be affected by more than just cognition, suggesting a focus on meta-experiences including understanding one's own learning through cognition, affection and conation (Efklides, 2008).

Metacognitive choice defines the selection of what is perceived to be the most appropriate cognitive response from a set of available responses (Haynie et al., 2010). This means that depending on the context of the individual's goal, a specific decision-making strategy will be selected and used to manage a changing environment. A cognitively adaptable individual, drawing on metacognitive knowledge and experience, can generate multiple, alternative strategies to make sense of changed external conditions, and select the most appropriate.

Metacognitive control represents the process of re-evaluating and adapting motives, metacognitive resources, and the formulation of appropriate metacognitive strategies for managing a changing environment (Haynie et al., 2010). They suggest that it allows a person to reflect on how, why, and when to use certain strategies. For example, one aspect of metacognitive monitoring is recognising task demands involving monitoring compliance with the planned sequence of processing and the time schedule that was set, the detection of errors and/or delays in execution, the detection of discrepancies between action and plan and checking the appropriate application of strategies (Efklides, 2008). Part of monitoring is also assessing the outcome of task processing involving processing against previously established criteria or standards that pertain to a certain quality (Veenman & Elshout, 1999). They may also involve strategies for the assessment of the quality of the planning, regulation and implementation of the strategies that were used.

Since now the focus has been on defining metacognition and revealing its theoretical components. In order to successfully adapt the full extent of metacompetencies and metacognition, one has to be aware of them and capable of using them in a systematic manner. This involves the metacognitive awareness of the person.

Schraw and Dennison (1994) suggest that metacognitive awareness is something that makes it possible to plan, sequence and monitor learning so that performance is improved. Moreover, Schraw (1998) has argued that promoting metacognition begins with building an awareness that metacognition exists and increases success. Therefore, it can be argued that awareness is an integrated part of the metaprocesses in learning; that is, it is difficult to develop meta-

abilities without an awareness that the development is happening. This is supported by Sheorey and Mokhtari (2001), who have suggested that metacognitive awareness is connected to executing appropriate actions to achieve a particular goal. 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). Furthermore, it has been found that when both entrepreneurs and individuals with high task-mastery skills present a higher level of metacognitive awareness, this supports the desired outcomes of their respective actions (Haynie et al., 2010; Vrugt & Oort, 2008), and that increased awareness about one's thinking patterns results in enhanced critical thinking facilitated by metacognition (Magno, 2010).

Metacognition is attracting rapidly increasing attention not only in scientific discussions about entrepreneurship and how to improve entrepreneurs' abilities to manage the uncertainty related to their everyday actions, it is equally important in the educational context to help individuals to better manage their learning. People who are more aware and responsible for their own thinking, learning and behaviour could perform better than those who are not. For example, Mokhtari and Reichard (2002) have proposed that individuals have an ability to enhance their study outcomes through increased awareness of their own thinking when reading, writing and solving problems. Ibabe and Jauregizar (2009) share a similar view, suggesting 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.

1.4. Metacognition, success in learning and employability

The idea of enhancing metacognitive abilities in university focuses on developing individuals who are more conscious and responsible for their own thinking, learning and behaviour, so they could perform better not only in studies but also after graduation, aiming to increase their employability. 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. In terms of increasing the success of students, the MMA instrument used in this thesis holds that such individuals put, for example, more value into thinking about what actually needs to be done (e.g. *I think about what I really need to accomplish before I begin with a task*), asking questions before starting to solve a problem (e.g. *I ask myself questions about the task before I begin*), and choosing the proper strategies for the task (e.g. *I am aware of what strategies I use when engaged in a given task*). Hence, employability serves as a critical condition for career success, and it is a continuous fulfilling, acquiring or creating of work through the optimal use of the competencies of a person (Van der Heijde & Van der Heijden, 2006). In line with that, past research has asserted that the employability of a person entails metacognition (Yorke &

Knight, 2004), and that promoting metacognition enhances the employability of students (Fynn, 2007).

Scholars have also argued for the importance of self-management as a vital competency in a person fostering their success. In order to realize the full potential of a career, a person should develop self-management competencies, and individuals who reflect more actively about their goals and know what they want to attain, also report a higher level of success (De Vos & Soens, 2008). Thus, there exists a relationship between competency development, career success and the employability of a person (De Vos, De Hauw, & Van der Heijden, 2011).

Still, it has been contended that teaching and learning methods that facilitate career development and the success of students need also to be personally engaging, and be based on the active involvement of students (Watts, 2006). Such methods can include, for example, role-play and problem-based or self-directed learning. Hence, the students who are more used to monitoring their learning (adopting self-regulated learning, involving metacognition) will perform better (Vrugt & Oort, 2008). As a result of this, students can become more motivated about their learning and feel increased control over the development of their success. Besides, the experiential and problem-based learning model facilitates metacognition and consequently encourages self-directed learning (Johnson, 2006). Moreover, scholars have asserted that increasing group work in school (Fitzgerald, 2010), and integrating this with real-world experiences motivates students to engage in metacognitive, reflective thinking (Ehiyazaryan & Barraclough, 2009), enhancing confidence and success.

At the same time, scholars have concluded that students who are able to self-regulate their learning, more easily understand their strengths and weaknesses in learning as well as the demands of specific tasks (Isaacson & Fujita, 2006). They follow that in order for students to be effective learners, they must adjust efforts based on their awareness and understanding of the level of the difficulty of tasks. Thus, students' ability to monitor their learning (i.e. the level of metacognition) is essential for success.

1.5. Metacompetencies in entrepreneurship education

It has been shown that communication-skills, coupled with creativity, analysis and problem solving, are among the core metacompetencies of a person, aiming to assist in developing other competencies (e.g. self-development) (Cheetham & Chivers, 1996). The findings of past research underline that metacompetencies (e.g. ability to learn, adapt and create) provide the necessary resources to develop competencies in specific situations (Lester, 1995), or that competencies are based on metacompetencies (Buckley et al., 2009). Scholars have also stressed that adaptability (relating to the ability to identify critical qualities for future performance) and identity (relating to self-assessment, self-related

feedback, and forming accurate self-perceptions) are two key metacompetencies related to learning (Briscoe & Hall, 1999). Therefore, it is possible that metacompetencies (consisting of self-development and adaptability) in students can be developed through appropriately focused entrepreneurship education. With that, metacompetencies enhancing the self-regulation and control of individual resources are regarded as central for learners in order to enhance their success and employability. It can be further argued that metacompetencies are required to enhance the flexibility of an individual in facing the demands of different tasks both in their professional career and in learning. Subsequently, in order to take maximum advantage of entrepreneurship education, a student should be equipped with the knowledge or awareness of his or her strengths and weaknesses in learning, leading to a better understanding about the demands of tasks resulting in increased performance. The development of enterprising and entrepreneurial competencies, together with professional knowledge and skills also increases the competitiveness of students and graduates on the labour-market. It can be expected that students have greater success when their skills and knowledge related to a specific field of studies are coupled with an understanding about how to use them creatively, to identify opportunities and exploit them.

Nevertheless, Barth et al. (2007) have focused their attention on justifying that although competencies are learnable but not teachable, higher education (focused on the development of metacompetencies) needs a reorientation of learning processes. The learning process should strengthen both self-reliance and self-direction in students through their own experiences; that is, encouraging learning-by-doing (*ibid*). As such, the learning process is able to activate risk-taking and creativity in students, as essential in entrepreneurship education (Jones & English, 2004). Drawn from this, the focus of entrepreneurship education should be to enhance levels of enterprising and entrepreneurial competencies through metacompetencies.

Importantly, competencies, subjected to development in earlier stages of education, can at the same time become basic cross-curricular competencies (i.e. metacompetencies) in later stages of training (Weinert et al., 2011). For example, reading and writing skills developed during early childhood serve in the development of more advanced competencies required in studies or in professional career. The findings of Cheetham and Chivers (1998) have in a similar manner underlined that metacompetencies interact to produce various competencies (i.e. outcomes of the process). They continue by sharing that changes in competencies, perceived by oneself or others, lead to activating reflection, allowing to adjust the level of metacompetencies. In connection with such reflections, therefore, metacognitive abilities serve as a precondition for the activation of self-regulatory processes, fostering independent learning in a changing environment (Kyrö et al., 2012).

Still, based on the tripartite model of the personality and intelligence of a person in education (Snow, Corno, & Jackson, 1996), further developed in the

context of entrepreneurship by Koiranen and Ruohotie (2001) and Kyrö et al. (2008), it has been underlined that all components of metacompetencies should be fostered, including metacognition, meta-affection and metaconation. Furthermore, differentiation between metacognition, meta-affection and metaconation is needed to complete a theoretical understanding of the interplay between these components, resulting in improving the learning process (Kyrö et al., 2012). Sitzmann et al. (2010) support this by noting that in past research, motivation has been seen as part of affective learning outcomes, suggesting there is still ambiguity about the exact contents of the metacognitive abilities of individuals.

Nevertheless, scholars have stressed the central role of metacognition (Ramocki, 2007), and that it can serve as an indicator of the metacompetency of a person (Weinert et al., 2011). Therefore, this thesis focuses on fostering metacognitive abilities, and its role in fostering entrepreneurship education and success in students.

1.6. Measurement of the level of metacognitive abilities

In parallel with the discussion about the nature and characteristics of metacognitive abilities, it is vital to be able to measure their effect directly and explicitly. To this end, multiple instruments have been developed to capture different aspects of metacognition either in terms of 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) (Table 1).

The importance of the role of motivation, affecting the degree of active involvement with tasks, individuals beliefs about their abilities and competencies, and success in self-regulation has been acknowledged in the past by several scholars, as argued earlier in chapter 1.1. Pintrich and De Groot (1990) followed that motivation is connected to self-regulated learning (or metacognition) through students' beliefs about their ability to perform tasks, beliefs about the importance of tasks and emotional reactions to tasks. They developed a 56-item measurement instrument *Motivated Strategies for Learning Questionnaire* (MSLQ).

It has been contended that students who are motivated to learn, and believe that their schoolwork is interesting and important, are also more engaged in learning and comprehending the material (i.e. are capable of engaging in more metacognition). In addition, such students are more independent in their learning and persevere longer at difficult or uninteresting academic tasks than students who do not believe they can perform the task.

The same concept of metacognition has been followed by O'Neil and Abedi (1996), who have additionally included the role of awareness, arguing that it is

not possible to take advantage of metacognition without being consciously aware of it. In line with this, they define metacognition as conscious and periodic self-checking of whether a goal is achieved. Based on this, they have provided a 20-item measurement tool known as the *State Metacognitive Inventory* (SMI), involving four subscales of metacognition: planning, monitoring, cognitive strategies and awareness. Therefore, it is assumed that higher levels of metacognition would lead to better academic performance, and that higher levels of metacognition would be exhibited during more difficult tasks by individuals with higher levels of education. Moreover, they argue that the MSLQ does not explicitly distinguish the components of metacognition (e.g. planning). This becomes especially critical in an attempt to more specifically determine the strengths and weaknesses in the metacognitive abilities of a person. Besides, although scholars have argued in favour of the instrument known as the *Learning and Study Strategies Inventory* (LASSI), developed by Weinstein et al. (1987) as a measure of metacognition (e.g. Downing, Ning, & Shin, 2011; Sandi-Urena et al., 2011), O’Neil and Abedi (*ibid.*) suggest that its focus is on study strategies and not on metacognition. Therefore, LASSI is not covered in this review of metacognition measurement instruments.

Table 1. Metacognition measurement instruments

Full name	Short name	Year	Authors
Motivated Strategies for Learning Questionnaire	MSLQ	1990	Pintrich and De Groot
Metacognitive Awareness Inventory	MAI	1994	Schraw and Dennison
Knowledge Monitoring Assessment	KMA	1996	Tobias and Everson
State Metacognitive Inventory	SMI	1996	O’Neil and Abedi
Metacognitive Awareness of Reading Strategy Inventory	MARSI	2002	Mokhtari and Reichard
Generalized Measure of Adaptive Cognition	GMAC	2005	Haynie
Metacognitive Expertise – Assessment Tool	ME-AT	2008	Pang

Source: compiled by the author

The measurement of the metacognitive awareness of people is similarly addressed by Mokhtari and Reichard (2002), who agree that awareness and monitoring of one’s comprehension processes are critically important aspects of skilled reading. Therefore, students can enhance their learning by becoming aware of their thinking processes when reading, writing or solving problems at school. Such information can also help teachers to better understand the needs of

their students. In order to assess metacognitive awareness and the perceived use of strategies while reading school-related materials, the researchers designed a 30-item instrument referred to as the *Metacognitive Awareness of Reading Strategies Inventory* (MARSII). However, this instrument was designed for use among students between 6th and 12th grades, thus not involving the context of academic studies at university or entrepreneurship education.

Although research on measurement instruments has largely focused on cognitive processes controlling and regulating learning, Tobias and Everson (1996) have acknowledged that affective processes have received less attention. This can have an impact to the accuracy of determining the level of metabilities in people. With that they have argued for the importance of making accurate metacognitive estimates about whether new material has been learned, in addition to assessing if students have retained prior learning. Tobias and Everson have also shared that improving the accuracy of monitoring will enhance student ability to concentrate on new materials and skim over familiar content. For this purpose the measurement instrument *Knowledge Monitoring Assessment* (KMA) aims to evaluate the discrepancy between student estimates and their actual knowledge or ability (determined by their performance in a test). Based on this, students with less effective monitoring ability spend more time reviewing what they already know, rather than focusing on new material or updating partially learned content. Thus, such students, with less developed metacognition, might face difficulties when working with increasingly complex tasks either during studies or in building professional careers.

It is evident that none of the approaches described above cover the full extent of metacognition, as acknowledged by Pang (2008), in that studies primarily explore only a few selected variables. In this regard, the 52-item *Metacognitive Awareness Inventory* (MAI) developed by Schraw and Dennison (1994) stands out as an attempt to fill this gap. In addition, this instrument has been developed specifically for the purpose of studying metacognitive awareness among students in university contexts. The instrument measures metacognitive awareness in the context of components categorized under the two groups – *knowledge* (i.e. the reflective aspect of metacognition) and *regulation* (i.e. the control aspect of learning). Knowledge of cognition therefore aims to measure awareness of strengths and weaknesses, knowledge of different strategies and when it is most useful to apply them. Regulation, instead measures planning, implementing, monitoring and assessing the use of strategies. Based on this, they have stated that metacognition is highly multidimensional and includes many different components. This has also been asserted via many studies in various academic settings. Hence, the MAI is a widely used instrument with findings showing that the gender of students does not have a significant influence on metacognitive awareness (Memnun & Akkaya, 2009; Stewart, Cooper, & Moulding, 2007), but students grades or performance (Batha & Carroll, 2007; Young & Fry, 2008), and the level of their self-confidence (Kleitman & Stankov, 2007) are significantly affected by the level of metacognition.

However, although these findings indicate there is a link between academic achievement and the level of student metacognition, it has been argued that, in using the MAI, it is not evident which components contribute most to the development of metacognitive abilities in students and in what combinations (Pang, 2008). With that, Pang has argued for the more complex model of metacognition, which would better follow its multidimensional and multifaceted nature. Thus, in order to examine the level of what she refers to as *metacognitive expertise*, the 50-item measurement instrument *Metacognitive Expertise – Assessment Tool* (ME-AT), reveals ten underlying components. In her research it has also been argued that by involving different complex components of metacognition, higher levels are more evident among high-achieving students (based on their grades). Hence, it has been argued that the ME-AT instrument can be applied to identify strengths in the metacognition of students in more detail and provide training to overcome any weaknesses.

However, instruments intended for use among students in universities are limiting in the sense that they are, to a large extent, not suitable for studying entrepreneurs or the entrepreneurial context. This is due to differences between the environments in which students and entrepreneurs act. This provided the motivation for Haynie (2005) to develop a more context-independent 35-item measurement instrument (GMAC), which is applicable among students and entrepreneurs. It is also significant that this instrument identifies metacognition through the cognitive adaptability of a person. This seems to be a valid approach among all enterprising individuals whose success or failure depends to a large extent on the degree of their adaptability in rapidly changing surroundings. Hence, the ability to adapt in step with the surrounding environment allows the student to become more flexible about selecting different study strategies, how they implement them while making understanding new material easier. Furthermore, a person that is more adaptable is more likely to deliberately seek new ways of attaining goals instead of using the same approach or strategy for every task, thereby contributing to improving his or her performance.

This thesis, draws heavily on the GMAC instrument primarily for two reasons. First, it introduces the concept of cognitive adaptability as a basis for the success of a person in a changing external environment, which is relevant in the circumstances under which entrepreneurs operate. Furthermore, it is context-independent so that it can be used for studying students and entrepreneurs. Secondly, the GMAC instrument is an attempt to adopt a more comprehensive approach to metacognition compared to other available instruments. It suggests that there are five components of metacognition – goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice and monitoring (i.e. metacognitive control). Furthermore, this instrument makes it possible to create a new approach to assessing entrepreneurship education courses. In addition, it provides an opportunity to enhance the level of entrepreneurship education so that student metacognitive abilities and their employability on the labour-market will be increased.

2. METHODOLOGY

2.1. Methodological choices

Scholars have pointed out that decisions regarding methodological choices are important not only for better understanding of the surrounding world but also for the quality of the results (Onwuegbuzie & Leech, 2005). With that the philosophical approach as a view of the world, and a basis for methodological choices regarding the measurement of changes in individuals' metacompetencies and thinking, must be defined.

The subject of the research in this thesis concerns the development of metacompetencies in individuals. This, by nature, is a social activity taking place in interaction with others and with the surrounding environment. At the same time, the development of metacompetencies and metacognition in students can be studied only through changes in their perception of the self or by looking at changes in their behaviour. Our knowledge involves the sensations of metacognition. In line with that, the philosophical approach applied in this research is critical realism.

The core concepts of critical realism have been developed as an alternative research approach for the social sciences. According to this approach there is a reality which exists independently of our knowledge and how it is perceived (Courvisanos & Mackenzie, 2011). In other words, reality (i.e. the metacognition of students) is only partly accessible for our direct observation. Additionally, to see it as it really is, one must learn and later reflect critically on what was learned and how it was perceived, addressing the role of retrospective monitoring in developing metacognition. Critical realism also suggests that the causal link between the phenomenon (i.e. level of metacompetencies and metacognition) and how it is perceived or experienced by a person is not activated automatically but depending on the presence of different conditions (e.g. intention or motivation). In line with that, two individuals might have similar capabilities that equip them to become successful entrepreneurs, yet because of different socio-economic or other conditions only one of them might realize this potential (Blundel, 2007). With that, metacognition cannot be separated from the person itself, and the context in which the development happens needs to be taken into account. Critical realism also states that in order to understand and change the social world it is necessary to identify the structures that generate events (Bryman, 2004). Hence, in the context of this thesis, in order to develop the metacompetencies of students, the task of a researcher is firstly to study what comprises metacompetencies and metacognition in students in learning. Subsequently, critical realism fits the author's understanding of the research subject.

Adopting the described philosophy also demands that the researcher use a certain research approach. As explained by Cohen et al. (2011), in subscribing to

the view that the surrounding social world and the phenomena in it make the objective reality existing externally from us, the research should predominantly focus on analysing the relationships between factors in that world. They continue that in this case the research should include more quantitative methods concerned with identifying elements and discovering how relationships are expressed to us. This thesis is an attempt to elaborate on the structure of metacognition in students with a focus on facilitating the development of their respective abilities through learning. This means that relying more on the principles of quantitative research (involving more tools for statistical data-analysis and analytical modelling) allows for a better comparison of the levels of metacognition in individual students and helps determine the degree of change in relationships between components.

2.2. Working with literature

Understanding a philosophical worldview and research approach affects the methods for finding and reviewing existing knowledge about the research subject. As expressed by Hart (1998), the review serves as a justification for the selection of the research topic, design and methodology. He has also noted that it is necessary to be flexible and persistent in this process.

The findings presented in this thesis use streams of literature from different fields of science including entrepreneurship, cognitive psychology and education. In order to increase the efficiency of finding relevant sources, it has been decided to combine different search strategies for all the research tasks. This involves taking advantage of domain-specific, trusted review and snowballing search strategies (Sørensen, 2004). Although, the choice about which strategy to use in a specific situation has been largely decided based on the demands of the situation alone; nevertheless, it is possible to describe an order of how the different strategies have been utilized throughout the research.

With that, the strategy used for working with the literature for this thesis was domain-based. This strategy takes its starting point from a precise definition of the term under study and was therefore used to find references to core terms and resources in the domains of entrepreneurship (e.g. entrepreneurial and/or enterprising abilities), cognitive psychology (metacompetencies, metacognition, metacognitive awareness), and education (e.g. entrepreneurship education). The domain-based strategy was suitable for working with the literature especially in the early stages of the research, when it was necessary to study seminal works related to developing metacompetencies and metacognition in entrepreneurship education. While this strategy made it possible to reveal relevant influential scholarly works and major schools of thought, it also involved a trial-and-error approach in finding the relevant results. This resulted in making the entire process significantly time-consuming, although providing the possibility to find an

exact match. Drawn from that, in the next steps of the research it was necessary to combine domain-based with other available strategies in order to improve the efficiency of working with the literature.

In order to better identify the relevant information, the author extended the use of the domain-based strategy with the trusted-review approach. This involves reviewing data from a limited amount of trusted high-quality sources (e.g. databases or journals). In terms of the topic of this research, this involves focusing attention on entrepreneurship domain-specific journals such as *Entrepreneurship Theory and Practice*, *Journal of Business Venturing* or databases *EBSCOhost Web*, *Emerald*, *ScienceDirect*, *SpringerLink* and *Wiley*. Adopting the trusted-review strategy made it possible to find additional relevant resources which had not come up in earlier searches, contributing to improving the overall quality of the research. Aside from that, it is also important because combining the two strategies served to formulate the worldview for the study. Moreover, this helped both to combine and clarify the research questions and hypotheses.

However, as noted by Sørensen (*ibid.*) it is often not possible to apply the trusted-review strategy without the elements of snow-balling. This has also been apparent when working with the literature in this thesis. The logic of implementing snow-balling lies in selecting a few highly relevant articles and looking at their list of references for any other relevant sources to the subject of the study. With that, the snow-balling strategy could easily be combined with the other two approaches to find and present the most relevant scholarly resources.

2.3. Study design

Following the theoretical framework of the thesis, and focusing on the assessment of the level of metacognition in students, this thesis is based on an instrument developed by Haynie (in Hisrich, Peters & Shepherd, 2007). This measurement instrument, referred to as *Generalized Measure of Adaptive Cognition*, has been developed from the *Metacognitive Awareness Inventory* (Schraw & Dennison, 1994) with the aim to extend its applicability among entrepreneurs. Drawn from this, it is possible to further develop the GMAC measurement instrument.

During the first phase of the research, the aim is to study how entrepreneurship education affects the level of metacognition in students. For this purpose the extent to which the GMAC measurement instrument can be used in the chosen context was tested. As a result, it is possible to adjust the instrument for the purposes of the assessment of metacognition in students participating in entrepreneurship education courses, in order to study how to develop entrepreneurship education in universities for the development of

student metacompetencies, aiming to foster their enterprisingness and success. In order to investigate how the success of individuals can be fostered by developing the level of their metacompetencies within the context of entrepreneurship education, this thesis is based on several inter-linked empirical studies.

The first study aims to identify whether entrepreneurship training has an effect on the level of metacognition in the respondents. 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 after a training course. In addition, the *Generalized Measure of Adaptive Cognition (GMAC)* measurement instrument was assessed as to whether it was applicable for revealing the structure of the metacognitive abilities of students.

The questionnaire included 35 different statements on a 10-step scale, divided into five sections covering *goal orientation*, *metacognitive knowledge*, *metacognitive experience*, *metacognitive choice* and *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 addition, to find further evidence about factors contributing to changes in metacognition, an attempt was made to identify students who are more inclined towards being entrepreneurial. Students were asked to complete the psychological portrait test by Hisrich and Peters (1989) aimed at determining their propensity towards self-confidence, independence and risk-taking.

The second study, in parallel, is an attempt to identify the impact of entrepreneurship education on different components of metacognition among different groups of students (i.e. metacognitively high- and low-achievers). For this purpose, the *K-Means* clustering methodology is used. Because the sample is from the first study and extended using a set of additional students, the survey design is similar to the first study – a quantitative single-group pre-test – post-test survey design. This allows a comparison of the results of both studies. In order to recognize groups of students with different characteristics, the survey is complemented by the application of factor analysis and clustering methodology.

The third study adds additional elements to the research sample in order to elaborate the empirically tested the GMAC measurement instrument. In order to ensure that the instrument can be used to better assess the level of metacognitive abilities in the respondents participating in entrepreneurship education courses, the MMA measurement instrument has been developed. In this process the factor analysis is conducted, which suggested discarding those statements which present only weak correlations, and reorder some other statements between the components. In addition, the reliability of the measurement instrument is assessed to determine whether the MMA is more applicable for measuring the level of metacognition compared to the GMAC.

The fourth study focuses on empirically testing the MMA instrument developed earlier among students studying different non-economic disciplines. In order to study the role of different study methods, the sample of students also

includes datasets of respondents participating in a short and very intensive voluntary entrepreneurship course. For the purpose of identifying the groups of students, the same K-Means methodology as in the second study is utilized.

The purpose of the fifth study is to provide evidence about how to enhance entrepreneurship education courses to foster the metacognitive abilities of students. In this context the respondents were asked to complete the questionnaire for the MMA instrument. The related datasets include both the students taking part in mandatory and voluntary entrepreneurship courses. In order to identify aspects of metacognitive abilities needing the most attention, the weakest statements have been chosen for closer analysis. This includes students taking part in both mandatory and voluntary entrepreneurship courses.

These five studies should collectively provide information about how to foster enterprisingness and entrepreneurial behaviour in students with a focus on metacognition helping them to build successful professional careers.

2.4. Data collection

All the empirical datasets used in the current research have been collected at Tallinn University of Technology (TUT) among undergraduate and graduate students, between 2008 and 2011. For the first step, the datasets were collected during the fall semesters of 2008 and 2009 from students taking compulsory entrepreneurship training courses, lasting through the entire semester (i.e. 16 weeks and 48 hours). This resulted in a sample size of 195 respondents from different engineering-related disciplines. The variety of disciplines included information technology, chemistry, thermal engineering, production engineering, mechatronics and physics.

In the second step, these datasets were complemented with data collected in 2010, adding 85 students from non-economic disciplines. Consequently, the entire dataset involved 280 students and spanned three academic years (2008–2010). This made it possible to increase the size of the sample and therefore increase the validity, and extend the variety of disciplines (involving logistics, and disciplines from the field of natural and technical sciences).

In the third step, the existing dataset was extended using an additional secondary sample of 79 respondents participating in a short and intensive (i.e. 24 hour) voluntary entrepreneurship course during 2009 and 2010. The purpose of the course was, besides writing a business plan, to develop the creativity, innovative thinking, self-assessment skills and teamwork necessary for an enterprising future. These courses were voluntary, with the assumption that the participants were more motivated to learn about entrepreneurship.

2.5. Data analysis

The results from the students in the initial sample in the compulsory courses were analysed both by exploring the properties of the datapoints on the 10-step measurement scale and the factor analysis to identify whether the components of metacognition can be identified. In addition, in an attempt to better reveal what causes changes, and to test whether the five-component structure of metacognitive abilities of students proposed by Haynie is evident, the Bayesian Dependency Modelling is also utilized. For the purposes of conducting Bayesian modelling, a web-based application B-Course (<http://b-course.cs.helsinki.fi/obc/>) has been utilized because of its simplicity of use and prompt presentation of results.

Still, the sample students also participated in several other courses besides entrepreneurship education. Therefore, in an attempt to explain changes in student learning, the author accepts that entrepreneurship training is not the only contributing factor. Nevertheless, entrepreneurship education courses are considered to provide the best opportunity for developing metacompetencies and metacognitive abilities in students.

The results from the extended set of respondents participating in mandatory entrepreneurship courses have been additionally analysed by means of linear statistics, confirmatory factor analysis and clustering (*K-means* method), making it possible to identify the students with higher and lower levels of metacognition. For the purpose of testing the measurement instrument among students using different study approaches, the results of the additional group of students taking part in the voluntary entrepreneurship course have been submitted to similar linear statistics and *K-Means* clustering analyses.

K-means as a combinatorial data analysis clustering method aims to maximise intra-cluster similarity and minimise inter-cluster similarity between individual datapoints. For compatibility reasons with a Likert scale, Euclidian distance was chosen as the similarity function for this study. Using the *K-means* clustering method, based on the results of hierarchical clustering and considering the intra-cluster sum of squared errors, the students were divided into five groups, presenting at least 40 respondents in a cluster. As a result of conducting the cluster analysis, each respondent was assigned to a group of similar students.

Still, before conducting the factor analysis on the sample, the linear correlation between variables has been examined in order to make sure that the variables meet the criteria for executing a factor analysis. The strength of linear dependencies permitting the inclusion of the statement in the analysis is set between .3 at the lower and .7 at the higher end. Therefore, statements with a linear dependency of less than .3 were removed from subsequent analyses. The factor analysis has been conducted using a maximum likelihood analysis with oblique, promax rotation, ensuring that estimates converge quickly. As a result of the factor analysis, six statements were discarded, leaving 29 for subsequent analyses. This is followed by a closer look examination of the meaning of the

statements, in order to evaluate the impact of the modifications, as an additional eight statements have been rearranged in this process.

The validity of the resulting modified measurement instrument *Measure of Metacognitive Awareness* has been determined by calculating the reliability parameters for both GMAC and MMA instruments in terms of the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Cronbach's alpha. This is carried out for each of the five components of metacognition.

3. RESULTS

3.1. Development of a new approach for the assessment of entrepreneurship education in university

Previous research on the assessment of entrepreneurship teaching programmes has drawn attention to the limitations of assessment practices focused on new venture or job creation as being misleading and short-sighted (Fayolle et al., 2006). Therefore, this study has been dedicated to assessing students attitudes toward entrepreneurial behaviour and entrepreneurial intentions (Hytti & Kuopusjärvi, 2004; Souitaris, Zerbinati, & Al-Laham, 2007) or the influence of social and environmental factors (Lüthje & Franke, 2004). The impact of entrepreneurship education on student intentions were also assessed by Fayolle et al. (2006) applying a methodology based on the theory of planned behaviour (Ajzen, 1991).

In this thesis, the focus of assessment is on the development of more general competencies (i.e. metacompetencies) in students, and particularly metacognition. It follows the widely acknowledged notion that a person's thinking affects his or her enterprising outcomes, leading to suggest that there is a need for different learning environments involving action-oriented and experiential learning styles, complemented with project-based, creative approaches which reflect how entrepreneurs actually live and learn (Collins, 2006; Jones & English, 2004; Löbner, 2006; Pittaway & Cope, 2007).

Considering the dynamic and unstable environment of entrepreneurship, metacognition plays a role in how people adapt to their developing and changing circumstances (Haynie & Shepherd, 2007). By taking a metacognitive approach to education, educators can thereby induce metacognitive thinking, enabling students to better gain knowledge about cognition and knowledge about the regulation of cognition (Schraw, 1998). Therefore, the inclusion of metacognitive elements in a teaching curriculum would be considered to be just as important as the content of the teaching curriculum itself; and entrepreneurship educators would be responsible for understanding how to develop such a metacognitive curriculum (Mitchell, et al., 2005).

The aim of the current study is to assess the entrepreneurship training results through changes in the metacognitive awareness of participants. The research addresses this in terms of the following hypotheses:

H1: The outcomes of entrepreneurship education courses that intentionally aim to change the metacognitive abilities of students have a positive correlation with student willingness to engage into entrepreneurial activities (Appendix1).

H2: Different components of metacognitive awareness are differently influenced by entrepreneurship education courses (Appendix1).

To achieve this goal, a GMAC cognitive adaptability questionnaire was used to evaluate the awareness of the participants and the extent to which they reflect, think strategically, plan, know which is useful knowledge or skills for them and analyse or monitor themselves. An additional psychological profile questionnaire was used to divide students into two groups based on the extent to which they were inclined to be entrepreneurial (H1). To test H2, a factor analysis and Bayesian Dependency Modelling has been used.

The survey results showed rather high scores on the 10-step scale (7–10) of students participating in the course, meaning that on average they have a rather high awareness of their own thinking processes. Already at the beginning of the training courses, the students assessed the level of their metacognitive abilities towards the higher end of the measurement scale for all five components. However, the comparison of the average assessments at the beginning and at the end of the course shows a small rise, indicating that entrepreneurship education has increased the metacognitive awareness of the students. When comparing the results of the survey for the two groups of students (entrepreneurial and non-entrepreneurial), the entrepreneurial are more metacognitively aware of goal setting, adopting strategies to find solutions and monitoring processes compared to the non-entrepreneurial students. This shows there is a positive correlation between student metacognitive awareness and their willingness to engage in entrepreneurial activities, confirming hypothesis H1.

Further, the unrestricted factor analysis, conducted on the empirical dataset in order to examine whether the five components of metacognition are present, reveals that the five statements are independent from each other. Although, based on the values of the correlation coefficients, they might be removed from further analysis, this might also be caused by the limited size or other properties of the sample. Hence, at this point, it is required to study the statements in greater detail in further analysis.

The findings also indicate that students feel more comfortable with tasks they are already familiar with or when they have obtained complete information before starting the task. At the same time, metacognitive abilities relating to making tasks understandable or breaking complex problems down into smaller, easily manageable tasks, have been scored at the higher end of the measurement scale (see Appendix 1). Still, to a large extent, students seem to use the same strategies that have worked in the past, all over again. However, the findings reveal that abilities related to choosing between different strategies to achieve the learning goals have been scored lower, relative to other components of metacognition.

Herewith it can be noted that the students' thinking has been changed, expressed by changes in the strengths of the dependencies between different statements after the course (based on Bayesian modelling). The Bayesian Dependency Modelling reveals that the strength of the dependencies between the individual statements have on average grown stronger after the training course. More specifically, the findings indicate that both abilities to identify and choose

between ways to solve a problem (i.e. *metacognitive choice*) and monitor when the goal has been reached (i.e. *metacognitive control*) are the components presenting the greatest increase after the entrepreneurship training. This suggests that the thinking of students has become more controlled or structured during the training. Thus, students should have increased their knowledge about how to differentiate the most important knowledge (for the task or during learning) from the less important, and use this knowledge to increase the learning outcome and its performance.

At the same time, abilities related to organizing both the time and available information have remained at almost on the same level after the training course, suggesting that there is potential for improvements. It is also essential that the students' thinking has become increasingly systematic in terms of recognizing the importance of making the task or exercise at hand more understandable before actually beginning to solve it. Drawn from that, the students have on average scored a higher level of metacognition for all five components, supporting previous research findings that contend that the level of metacognitive abilities and success in people can be fostered with learning (e.g. Batha & Carroll, 2007; Blom & Severiens, 2008; Schraw, 1998; Vrugt & Oort, 2008). Besides, it can be that the entrepreneurship training has had a positive impact in terms of reducing the over-confidence of students relying on thinking patterns that have worked previously, and increasing critical goal-setting skills.

Nevertheless, the changes in the level of metacognitive abilities remain small. Hence, entrepreneurship education programmes might be turning less attention to the development of metacognitive abilities, although this should be a major focus. Entrepreneurship education has the potential to improve the abilities of students to regulate their learning and thinking in different circumstances in order to become more adaptable. Subsequently, students will become more accustomed to adjusting their thinking in response to external circumstances and think creatively and search for different approaches so as to increase their learning performance.

In conclusion, the analysis confirms that the level of student metacognitive abilities has improved and the importance of different statements have been changed; that is, different components of metacognitive awareness are differently influenced by the course, supporting hypothesis H2.

These results demonstrate the possibility of assessing the effectiveness of entrepreneurship training by observing changes in the metacognitive abilities of the participants. Furthermore, the contribution of these results is in proving that entrepreneurship education programmes have an effect on changing the way individuals think when faced with tasks in unfamiliar conditions. These results show that for the most part, the GMAC measurement instrument is applicable for assessment of the impact of courses, but it is necessary to modify it according to the aim of the study. The outcome of the factor analysis reveals the presence of eight factors that did not correspond to the theoretical assumptions. This could be due to instrumental failure. Therefore, developing the

abovementioned measurement instrument further represents a challenging perspective to increase the amount of empirical evidence and enhance the research of metacognition in educational settings.

The findings also indicate that it is desirable to include in educational programmes those elements that enhance metacognitive abilities. In addition, the development of entrepreneurship education through enhancing different metacompetencies in students allows us to gain more insight into student learning strategies.

In conclusion, the main contribution of solving the first task of the doctoral thesis provides new options for the development of entrepreneurship education in universities.

3.2. Development of a measurement instrument for capturing the level of metacognition in students

Although the focus of this research is to uncover the impact of metacognitive abilities in educational contexts and learning (Batha & Carroll, 2007; Downing et al., 2011), the amount of related empirical research is still rather limited. Despite the fact that several instruments are available to capture the diverse nature of metacognition, it is still uncertain what would be the most appropriate approach to take in assessing metacognitive abilities in students. The GMAC instrument developed by Haynie (2005) drawing on Schraw and Dennison (1994) is adjusted to assess metacognition in classrooms as well as in entrepreneurship contexts.

However, the current research (Appendix 1) contends that Haynie's instrument should be adapted to different contexts to make it suitable to capture the effectiveness of entrepreneurship education with respect to the level of metacognition in students. Moreover, the aim is to contribute to the discussion of metacognition assessment practices by further testing the applicability of the GMAC instrument among students in the Estonian sample. In connection with this, the following research questions have been developed:

Firstly, to what extent does Haynie's instrument work in the context of students with different professional and educational backgrounds? (Appendix 1; Appendix 2)

Secondly, how can the instrument be adapted to better assess the level of metacognitive awareness in different students participating in the entrepreneurship education course? (Appendix 2)

In order to provide an answer to the first research question, changes in students in the first sample have been monitored using Haynie's measurement instrument (GMAC). While testing the individual statements of the instrument for inclusion in the factor analysis, the results suggested the exclusion of five

statements (Appendix 1). These involve abilities related to applying strategies when solving problems (*I think of several ways to solve a problem and choose the best one; I find myself automatically employing strategies that have worked in the past; My "gut" tells me when a given strategy I use will be most effective*), and understanding the data (*I create my own examples to make information more meaningful; I re-evaluate my assumptions when I get confused*). Still, looking at the statements closely and applying Bayesian Dependency Modelling, there has not been sufficient evidence to argue for or against the exclusion of these statements. On one hand, the GMAC instrument aimed to measure metacognition – one component of the meta-abilities of a person. If this is correct, the five statements possibly expressed either affective or conative components instead. For example, the statement *My "gut" tells me when a given strategy I use will be most effective* refers to intuition, which is not metacognitive. However, *I think of several ways to solve a problem and choose the best one* concerns the ability of a person to think about multiple ways to solve a problem and selecting between them. Thus, based on Haynie, this refers to metacognitive choice and should not be excluded.

In line with this, the instrument has been further investigated using an extended set of respondents, assuming that it will present more evidence about the applicability of the GMAC (Appendix 2). The values of correlation coefficients between the variables, a preliminary step for conducting a factor analysis, suggested that six statements do not involve the metacognition of a person, but presumably other components of meta-abilities (i.e. meta-affectation or metaconation). Furthermore, it is interesting that from these six statements, four were also marked for exclusion using the first analysis described above. Thus, the statement *I think of several ways to solve a problem and choose the best one*, mentioned above, is appropriate for measuring the metacognitive abilities of a person. It means that in combination, statements *I think about how others may react to my actions* and *I depend on my intuition to help me formulate strategies* were additionally marked for exclusion. Based on this, students might feel excessively confident concerning their abilities, leaving less room for intuition. Hence, looking at these statements indicates that they involve more affective or conative responses to the task at hand. Drawn from this, from the six statements three involved the knowledge-component of metacognition, two the use of previous experiences and one the ability of a person to think about and select the most appropriate way to solve a problem.

Hence, the findings of the first research question reveal that the six statements in the GMAC have been considered independent from the rest, indicating that the meaning of information for the students is considered less important than completing the task at the required level. At the same time, it might also be that in order to counteract the risk of failure, students prefer not to pursue their own strategies, but instead to follow instructions given by someone else. Therefore, using Haynie's instrument in different contexts requires testing and adapting it to the environmental context.

In order to answer the second research question, the application of confirmatory factor analysis makes it possible to present a modified version of the measurement instrument, referred to as the *Measure of Metacognitive Awareness* (MMA). The MMA includes 29 statements, but it is equally important that eight of them have been reordered compared with the GMAC.

For example, the statement *I think of several ways to solve a problem and choose the best one* previously belonged in the knowledge-component of metacognition, but was regrouped as part of the choice-component instead (Appendix 2). Efklides (2009) has argued that meta-knowledge serves as a platform allowing the person to select different strategies regulate learning. Now, if a student is not equipped with the necessary awareness, leading to an inability to regulate their learning, it might be that knowledge of the self is not engaged in choosing the best learning approach. In parallel, *I ask myself if I have learned as much as I could have after I finish the task*, connects to the ability to adopt the results of a learning task with existing knowledge so that similar tasks could be solved more effectively in the future. Although the statement has been initially grouped to involve abilities to choose between strategies, the adoption of new knowledge with existing knowledge heuristics and decision-making strategies would address the metacognitive knowledge component instead.

In a similar manner, the statements *I perform best when I already have knowledge of the task* and *I try to use strategies that have worked in the past* involve knowledge about thinking, according to the GMAC. However, the more extensive the knowledge a person has in advance about the task, the greater the possibility that the task will be achieved using automatic cognitive responses. Therefore, actual meta-knowledge might not be engaged to an expected extent, and reflective monitoring abilities will be used more.

At the same time, the statements *I think about what I really need to accomplish before I begin a task* and *I organise my time to best accomplish my goals* have been classified into the meta-experience component. This follows Efklides (2009), who suggests that meta-experiences involve estimates, judgments or feelings concerning learning tasks. In addition, she contends that learning involving affect together with volition activates self-regulation through regulatory loops.

Finally, the validity of the MMA has been tested on both samples of students, confirming that compared with the GMAC instrument, the reliability of the MMA on average has not been decreased and it can be used for assessing the level of metacognition in the available context.

The contribution this study brings lies in that the MMA instrument has been elaborated and tested considering the context of learning entrepreneurship. Moreover, the results of the analysis have shown that the MMA can be used to assess the impact of entrepreneurship education through changes in the metacognitive abilities of students. However, caution needs to be exercised in order to clearly identify the context where it will be applied. Apart from this, it is believed that it would generate more research, applying the instrument to better

understand the impact of entrepreneurship education on student metacognitive abilities.

3.3. Assessment of the impact of entrepreneurship education on metacognitive abilities and the awareness of different groups of students

The level of metacognitive abilities is not static from one person to another, and also has an impact on how a person succeeds in a changing environment. The underlying assumption of related research is that some individuals are more likely to start a business no matter what difficulties they might encounter. Thus, success will not take place only due to the amount of time and effort devoted to activities – both successful and unsuccessful individuals are equally able to extract these resources.

Findings from past research have established that increased awareness of one's thinking patterns promotes greater success both in entrepreneurship (Ku & Ho, 2010) and academic settings (Young & Fry, 2008). The findings also indicate that individuals who are engaged in metacognitive activities to a greater extent than others, do not necessarily work more or longer, but spend the given time more effectively (Schmidt & Ford, 2003). This addresses the need to focus the research on different groups of students, in order to identify better how to improve learning and entrepreneurship education in universities.

Drawn from this, the research focuses on evaluating the influence of entrepreneurship education courses in terms of the metacognitive awareness of different groups of students (Appendix 3).

The research measures changes in different statements of metacognition and its components (incl. goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice and monitoring) in students as a result of entrepreneurship courses. The main proposition is that students with different characteristics are influenced differently through entrepreneurship courses. The empirical evidence has been collected on the basis of student self-assessments from two samples using different approaches to learning (i.e. traditional project-based and action learning). For the purpose of defining different groups of students, clustering is carried out.

Findings of previous studies (Appendix1) have shown that students, when asked to assess their abilities to choose between different ways of achieving learning goals and to monitor progress in achieving them, have on average assessed their abilities as poorer compared to other components of metacognitive ability. Looking more closely at this reveals that the students presenting lower levels of metacognition also lack resource-management abilities or they have not had good experiences with that. Furthermore, abilities related to choosing between different strategies and monitoring progress have changed less especially among students receiving a more traditional teaching approach (i.e.

the first sample) (Appendix 3). In addition, the findings suggest that the students with a lower level of metacognition, also score significantly lower in terms of assessment practices when performing the tasks. Still, considering that these students are able to set goals for themselves, it might be that they just do not value the effort or are not used to assessing their progress after the task has been achieved in order to learn from this in order to improve their performance in the future.

At the same time, abilities to set understandable and manageable goals have been scored significantly more highly among students with higher levels of metacognition. This could be because metacognitively high-achieving students might already be significantly more aware of their thinking patterns and metacompetencies before the training because of the characteristics of entire study programme, not only the entrepreneurship education programme.

Metacognitively high-achieving students seem to be more accustomed to making short stops during the problem-solving process in order to check if the task has been correctly understood (i.e. monitoring component, Appendix 3). This can be an indication that they are more used to not just completing the task at hand, but making sure that the purpose of the task and the way to solve it are understood. Nevertheless, low-achieving students seem to be only modestly aware about the role and importance of reflection and reflective practices in developing metacompetencies (Appendix 3). It can be that such students just do not consider this as an important part of a successful learning experience because during earlier stages in their education they have excessively focused on only getting facts-based knowledge and good grades in specific disciplines without any real need to make the entire studying-experience more meaningful.

In addition, it is evident that the gender of students is an important factor (Table 2). For example, among low-achieving students in the first sample, females have shown greater changes in terms of their ability to make tasks more understandable (i.e. MC knowledge, 12.0%), use previous experiences (i.e. MC experience, 11.1%) and make calculated choices (i.e. MC choice, 10.0%).

Table 2. Magnitude of the impact of entrepreneurship training among low-achievers between 1st/2nd sample (% on the scale of 0...100)

	Male	Female	Undergrad	Graduate
Goal orient.	11.5 / 13.0	8.6 / 18.0	10.0 / 15.4	na
MC know.	9.0 / 17.3	12.0 / 20.3	13.8 / 18.8	na
MC exp.	8.3 / 15.0	11.1 / 11.8	4.7 / 13.5	na
MC choice	4.5 / 12.7	10.0 / 18.0	7.0 / 15.2	na
Monitoring	8.1 / 13.6	4.7 / 14.9	7.0 / 14.2	na

Note: "na" denotes "not available"; changes among high-achievers do not exceed the limit of statistical significance

Source: author's extract from Appendix 3, Table 4

Male students, at the same time, developed more goal-setting (11.5%) and progress monitoring abilities (8.1%). However, the changes among students belonging to the second sample (voluntary course) were statistically insignificant.

Looking at undergraduate students, the abilities to use past experiences, choose between strategies and monitor progress increased significantly less in the first sample (i.e. 4.7%, 7.0% and 7.0% respectively). However, as graduate students did not belong to the low-achievers, it is not possible to indicate if study-level had an effect.

However, looking at this in terms of the difference between groups of metacognitively high- and low-achieving students reveals that it has decreased after the training among all components of metacognition. On the one hand, this might not be caused by entrepreneurship training courses alone. There are, after all, other courses and lessons taken by students during the semester. Consequently, it is reasonable to expect that additional latent variable(s) exist, which have not been covered within the scope of the current thesis.

Despite that, the findings reveal that entrepreneurship education has had less influence on the level of metacognitive awareness among the group of high achievers. It is also essential that based on magnitude, these changes in the first sample remain statistically insignificant among metacognitively high-achievers. Therefore, it might be that the teaching method did not support the development of metacognition in those students (Appendix 3).

Entrepreneurship education has, in parallel, produced relatively greater changes among low-achieving students. Before the training they presented the lowest levels in all five components of metacognitive abilities. After the training the same students indicate a greater than average relative increase in their assessments in all metacognitive components. More specifically, knowledge about metacognitive abilities has presented one of the greatest increases among low-achieving students in both samples (10.2% in the first sample and 18.7% in the second sample, Appendix 3). In addition, abilities related to setting manageable goals have been significantly changed by the training among low-achievers in all groups of students. Based on this, the students have become significantly more aware of how to make tasks cognitively understandable and to break them down into smaller pieces, if needed. Moreover, students' metacognitive abilities in the two different groups (i.e. high- and low-achievers) have become closer to each other after the entrepreneurship training, suggesting that the reasoning of low-achieving students has become comparable to that of the high-achieving (Appendix 3). Therefore, it is possible that on average the thinking of students has changed towards accommodating the patterns of high-achievers. At some level this might even be the expected outcome of training, affected by the group-learning nature of entrepreneurship courses. This addresses the idea that students develop thinking and the ability to take advantage of it better in interaction with others through creating an environment where metacognition could be better enhanced.

This study contributes to the field by establishing that the level of metacognition in different students is affected differently by entrepreneurship education courses. The courses had a remarkably positive effect, especially on students with only moderate or lower levels of metacognition before the training. The results of the study also reveal the need to consider differences in metacognitive awareness when designing programmes, including more individual approaches in the learning process, and enhancing entrepreneurship education courses to increase the benefits for the students.

3.4. Enhancing entrepreneurship education in engineering students to increase their metacognitive abilities and employability

The competencies of a person can be enhanced via teaching and learning (Boyatzis et al., 2002). 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, enterprising elements (Rae, 2010). Carey and Matlay (2010) have witnessed a consensus among scholars about the growing pressure on higher education to become both more enterprising and entrepreneurial.

In response to this, findings have asserted that being able to recognize and evaluate the learning of a person is important for reflecting thinking processes, and that making students aware of their learning can be promoted through metacognition (Boström & Lassen, 2006). It has been additionally confirmed that the entrepreneurial mindset, based on the ability of a person to be flexible, dynamic and self-regulating in changing environments, is metacognitive by nature (Haynie et al., 2010).

Abilities such as mental control and executive functioning are what is expected from enterprising individuals and entrepreneurs. Besides, skills that facilitate adapting to changing environments contribute to the economic security of individuals (Jack & Anderson, 1999), and entrepreneurial behaviour can be developed with appropriately focused education (Liñán et al, 2008). Therefore, entrepreneurship education has to include not only studies *for* entrepreneurship, but also *about* and *through* entrepreneurship (Carrier, 2005; Garavan & O’Cinneide, 1994).

The aim of this research is to seek ways to enhance entrepreneurship education for engineering students and develop their metacognitive abilities. In order to do so, the research questions are formed as follows:

Firstly, what are the weakest components of metacognitive abilities among different groups of students?

Secondly, how could entrepreneurship education be developed in order to increase the metacompetencies of students?

The empirical evidence of the study, in terms of the MMA measurement instrument, has been analysed using the *K-Means* clustering methodology. This

is complimented with datasets concerning the psychological portrait test by Hisrich and Peters (1992). Findings indicate that besides gender, looking at study disciplines alone does not provide reliable predictions of the degree of enterprisingness in individuals.

However, the research indicates that there is a surprising deficiency related to time-management (*I organise my time to best accomplish my goals* was scored low before the training), while this competency should be utilized by everyone engaged in any task (Table 3). Subsequently, students might need additional training on how to plan the steps to achieve their goals and to purposefully solve them with the available resources.

Table 3. Percentage of students with the weakest aspects of metacognitive abilities from the two samples before and after the course (% of the entire samples)

	First sample		Second sample	
	Before	After	Before	After
	N=126	N=82	N=35	N=21
<i>Goal Orientation</i>				
I ask myself how well I've accomplished my goals once I've finished	4.3	1.8	11.4	2.5
I organise my time to best accomplish my goals	7.9	6.1	6.3	
<i>Metacognitive knowledge</i>				
I challenge my own assumptions about a task before I begin	8.2	2.9	11.4	3.8
I ask myself questions about the task before I begin	10.4	2.5	10.1	
I try to break problems down into smaller components	7.5	3.9	7.6	
I ask myself if I have learned as much as I could have after I finish the task	12.9	6.8	16.5	7.6
<i>Metacognitive choice</i>				
I ask myself if there was an easier way to do things after I finish a task	6.4	4.3	6.3	6.3
I ask myself if I have considered all the options after I solve a problem	6.4	5.0	12.7	2.5
<i>Monitoring</i>				
I find myself analysing the usefulness of a given strategy while engaged in a given task	6.8	4.6	6.3	
I find myself pausing regularly to check my comprehension of the problem situated at hand	8.2	3.6	5.1	

Note: only the greatest shares have been shown

Source: author's extract from Appendix 4

Moreover, the ability to engage in retrospective self-assessment also seems to be under-developed among students. Asking questions after finishing with a task, in order to confirm what has been learned (*I ask myself if I have learned as much as I could have after I finish the task*), is not common among undergraduate and graduate students. This correlates with the inability of students to make calculated choices (both *I ask myself if there was an easier way to do things after I finish a task* and *I ask myself if I have considered all the*

options after I solve a problem have not been valued very highly). And even when students admit to setting goals and looking to achieve them, it seems that this is not a controlled process. This shows that assessment is not a regular habit, and is happening only when the result is very different from what has been expected. Students might need more practical examples about the usefulness of self-analysis, coupled with tasks forcing them to analyse the course of the steps they have taken, and how this relates to their employability on the labour market.

The findings also reveal that metacognitively high-achieving students might have more knowledge on how to adapt their existing knowledge to suit the demands of various learning tasks (Appendix 3). This contributes positively to enhancing the degree of systematic and controlled thinking. Furthermore, students underestimate the usefulness of making sure they understand the tasks clearly, and choosing between different strategies to reach the best results. The ability to switch flexibly between different strategies and to question assumptions equally needs more attention in entrepreneurship education.

In order to improve the assessment of achievement against the set goal, additional sub-goals and checkpoints might be necessary, and most importantly fixing the goal in the planning phase. At the same time, in terms of poor time management, and low interest in the results, it might also help to divide larger tasks into smaller ones. The checkpoints that make it possible to practise time management, while discussing expectations and possible outcomes of the task, could contribute to increasing student interest towards the learning task. Another useful strategy to improve challenging assumptions would be to allow students to express their beliefs about a task, so that a teacher could offer specific knowledge to challenge them. Moreover, it is believed that poor knowledge of different learning strategies could be improved by committing students to additional discussions, case-studies and problem solving tasks within entrepreneurship education.

This is supported by Veenman et al. (2006), who contend there are three fundamental principles for successful metacognitive instruction, which should be followed in educational programmes. Firstly, metacognitive instruction needs to be embedded in the content of the studies. Secondly, students have to be informed about the usefulness of metacognitive activities, so that they will become more motivated and willing to make additional effort in learning. Thirdly, it has been pointed out that in order to guarantee the smooth and continuous application of metacognitive activity, prolonged training is needed. Therefore, to facilitate deeper changes in learning, it is not enough to limit the metacognitive practices to only a few courses. Instead there is a demand for cross-disciplinary curricular-orchestration within the university and a high level of awareness of metacognition among lecturers must be the norm.

The contribution this study brings, is that in order to develop students with lower metacompetencies, entrepreneurship education courses should include a large variety of different active learning methods, which could be used in combination with more traditional ones. To be able to better cope in changing

environments, and feel satisfaction from learning, entrepreneurship education should also not concentrate on a few new learning methodologies but offer an integrated multi-methodical approach, developing different metacompetencies and meta-abilities in students.

3.5. Developing a model of enterprising and entrepreneurial competencies with the inclusion of metacompetencies for learning

A significant amount of previous research into metacompetencies in the field of cognitive psychology has also influenced developments in entrepreneurship education. In this relation, the findings of Kyrö et al. (2008, 273) have made a prominent contribution to the discussion by extending the original model by Snow et al. (1996, 247) and Koiranen and Ruohotie (2001, 104) in order to establish connections between different metaconstructs of personality and intelligence in the entrepreneurial context. In addition, Georgiades (2004, 366) states that all processes referred to in the definition of ‘meta-affection’ are either initiated or controlled by cognitive mechanisms, suggesting that anything ‘meta’ is heavily dependent on cognitive functions.

The need to consider different metacompetencies in the domain of the discussion of entrepreneurship education makes it possible to foster not only the research which is currently developing, but to provide valuable input for student learning strategies. Individuals who choose to become metacognitively aware and engaged are those who are interested in the tasks they work on and in parallel see value in it, fostering their employability. They are also more willing to invest effort into thinking what needs to be done (e.g. *I think about what I really need to accomplish before I begin with a task*), clarifying the problem before starting to solve it (e.g. *I ask myself questions about the task before I begin*), and selecting proper strategies for the tasks (e.g. *I am aware of what strategies I use when engaged in a given task*). Hence, enterprising and entrepreneurial competencies with the inclusion of professional knowledge and skills serves as a critical condition for career success supporting the employability of students (Appendix 4).

The central idea of the research is that there is a strong interplay between metacognitive, meta-affective and metaconative abilities, which emphasizes the need to consider all of these in future research. Boulay et al. (2010) proposes that meta-affectively intelligent systems focus on helping to increase the learner’s insight into his or her own feelings as a learner and also the ability to manage and regulate those feelings. And finally, meta-motivationally intelligent systems focus on helping the learner gain insight into his or her own motivation and ways of managing that are effective.

The findings of previous research has underlined that based on the tripartite model of the personality and intelligence of a person in education (Kyrö,

Mylläri, & Seikkula-Leino, 2008), besides metacognition, meta-affection and metaconation also have to be fostered. This presents a challenging perspective for researchers and serves as one of the factors contributing to the current limited amount of research, especially on meta-affection and metaconation in educational settings.

Nevertheless, scholars have stressed the central role of metacognition (Ramocki, 2007), and that it can serve as an indicator of the metacompetency of a person (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.

Metacompetencies are required to enhance the adaptability and flexibility of an individual (Brown, 2003), while adaptability and identity are 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 clear knowledge or awareness of his or her strengths and weaknesses in learning, leading to greater adaptability. The concept of metacompetencies and the model below (Fig. 1) contribute to creating a basis for future research to study how they could influence entrepreneurial and enterprising learning and behaviour in students.

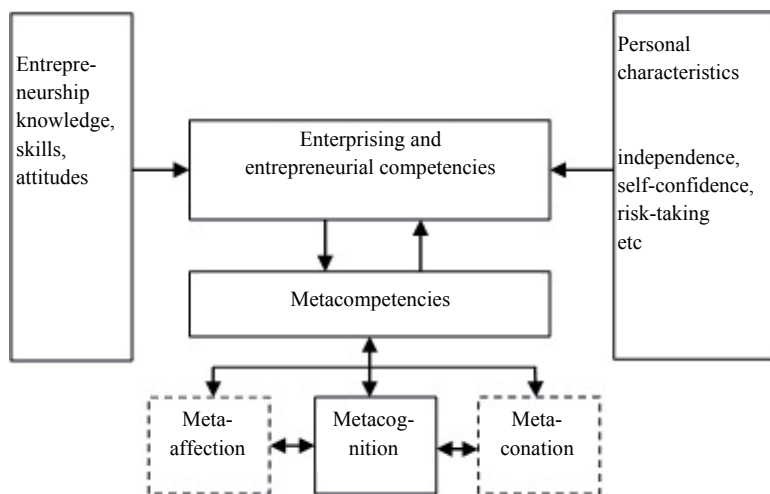


Fig 1. The model of the development of enterprising and entrepreneurial competencies in learning through metacompetencies

With that, a valuable contribution has been made to the development of a new concept of entrepreneurship education, involving the need to consider the role of different metacompetencies. In addition, based on this, the suggestions presented here aim to increase levels of metacognition through entrepreneurship education.

4. CONCLUSION

In order to increase the success of individuals in the labour market and in building their professional career, it is increasingly important to develop the adaptability and enterprisingness of individuals. Therefore, there is a need to foster not only skills in people, allowing them to foster outstanding professional knowledge, but also metacompetencies, allowing them to take advantage of skills in different circumstances and rapidly changing environments. This can be achieved by focusing education at all levels at enhancing lifelong learning, learning to learn and an awareness of thinking, leading to the development of an enterprising mind.

The current thesis focuses on how to facilitate the employability and success of students through the development of entrepreneurship education training in the university in terms of the level of their metacompetencies. The aim of the thesis is to contribute to the development of an assessment instrument for entrepreneurship education in universities aiming to foster metacompetencies and enterprisingness in student. With that, the thesis focuses on metacompetencies through metacognition. The empirical research in parallel aims to reveal aspects of entrepreneurship education that contribute more to the development of metacognition in students. Hence, the thesis is based on four interconnected research papers, which together, focus on the subject of improving the level of student success in learning at university and when building professional careers after graduation, thereby contributing to their employability.

This is addressed in terms of five research tasks:

Firstly, focusing on the development of a new approach to the evaluation of entrepreneurship education at university.

Secondly, in order to further elaborate the effect of entrepreneurship education courses, the thesis develops a measurement instrument for capturing the level of metacognition in students.

Thirdly, the thesis seeks to identify how to assess the impact of entrepreneurship education on metacognitive abilities and awareness in different groups of students.

Fourth, the thesis seeks to enhance entrepreneurship education for engineering students in order to increase their metacognitive abilities and employability.

Fifth, to develop a model of enterprising and entrepreneurial competencies including the metacompetencies of an individual in learning.

The research is based on the *Generalized Measure of Adaptive Cognition* (GMAC; Haynie, 2005) measurement instrument, which is used with a sample of students studying different non-economic disciplines at university. This instrument is chosen as the basis for the research because it includes a five-component structure, covering not only a few selected aspects of metacognition

but the concept in a more comprehensive way. It is also important that the instrument introduces the concept of cognitive adaptability as a measure of success in individuals. In addition, this instrument is context-independent; in other words, it can be applied both in universities (among students) and in entrepreneurship (among acting entrepreneurs).

The results and contribution of the research in terms of the abovementioned five tasks is as follows:

Task1. The analysis confirms that the level of metacognitive abilities in students improved after the training. Moreover, the importance of different aspects of metacognition has changed; that is, different components of metacognition are influenced differently during the learning process. Therefore, it is possible to assess the effect of entrepreneurship training by observing changes in the metacognition of participants. This makes it also possible to improve the abilities of students, to increase the monitoring of learning and thinking in different circumstances in order to become more successful.

Thus, the thesis contributes, firstly, in proving that education has an effect on changing the way individuals think when faced with tasks in unfamiliar conditions. Secondly, by presenting that the GMAC measurement instrument is to a large extent applicable for assessing the impact. Although, it is necessary to modify the instrument to suit the aims of the study. Consequently, this new approach to assessing the impact of education opens new opportunities for the development of entrepreneurship education in universities.

Task2: In order to address the need to further develop the GMAC measurement instrument, the findings present a modified version referred to as the MMA. This instrument has been tested on two different samples of students, confirming that it can be used to assess the level of metacognition and changes in the level among students.

The main contribution this brings lies in the fact that the GMAC instrument has been elaborated and the MMA has been tested considering the context of studying entrepreneurship.

Task3: The results of assessing metacognition in different groups of students indicate that those with lower levels of metacognition before the course display a greater than average increase compared to students with higher levels of metacognition. Therefore, the thinking of students with lower metacognition has become more comparable to those with a higher level of metacognition. It is also important that students with lower levels of metacognition have become significantly more aware of how to make tasks cognitively more understandable and to break them down into smaller pieces. However, they lack resource-management abilities, which are crucial not only in entrepreneurship. In addition, these students have deficiencies in terms of assessment practices when performing the tasks.

Students with a higher level of metacognition show significantly higher scores in terms of their ability to set understandable and manageable goals. At the same time, they are only modestly aware of the role and importance of reflection and reflective practices in developing their thinking and metacompetencies. Still, these students already scored in the upper end of the measurement scale (i.e. 80% and more) before the course. As the changes have remained small especially among students participating in courses with more traditional teaching approaches, the teaching method might not sufficiently support the development of their metacognition.

Aside from that, it is evident that entrepreneurship training has had a greater impact on females than males, and female students rate their metacognition higher than males.

The contribution of this study lies in establishing that the level of metacognition in different students is affected differently by the entrepreneurship education course. Therefore, differences in the metacognitive awareness of students have to be considered when designing course programmes.

Task4: The findings indicate that the ability to learn from already completed tasks is problematic both before and after courses. Students might be more accustomed to completing the given tasks without actually learning how to enhance their knowledge and skills. They seem not to sufficiently value the importance of identifying their strengths and weaknesses in learning. This could indicate that students have adopted an approach during their studies that simply aims to complete the task at hand. Still, the fact that the amount of these students has significantly decreased after the training suggests that after the courses they are more aware of how retrospective monitoring helps to achieve the goals of learning.

Nevertheless, asking themselves questions after finishing the task in order to make sure sufficient lessons have been learned, is not common among students. Deficiencies are evident in terms of choosing the best way to solve a problem (i.e. reviewing the chosen strategies), and asking whether everything has been taken into account to achieve a better performance (i.e. making sure the task has been fully understood). This indicates that self-analysis is not a regular habit, happening only when the result of actions is very different from what has been expected. Nevertheless, the students' weaknesses in reflecting upon how well they have understood a task can also be explained by the lack of providing students with the necessary experience during earlier studies.

In order to further improve the related abilities it would be useful to give students tasks which require them to incorporate elements of previous tasks, also directing them to analyse the usefulness of the available information. In addition, this facilitates critical information assessment skills and would help students improve their understanding of the context and requirements of tasks.

However, the findings also present a surprising deficiency related to time-management, which should be an ability utilized by everyone engaged in any task. Thus, students might need additional training in planning the steps to achieve their goals and solve tasks. Still, as this aspect is weaker among the students in the first sample, it could be the result of using traditional teaching methods focusing on lectures and both theoretical and impractical tasks. Therefore, the environment and approach for teaching entrepreneurship and enterprising behaviour needs to be modified to provide more real-life hands-on experience with practicing entrepreneurs.

This contributes by indicating that in order to help students with lower metacompetencies, courses in entrepreneurship education should include a variety of different active learning methods, which could be used in combination with more traditional ones. This would increase student satisfaction with learning achievement.

Task5: It has been underlined that all components of meta-abilities should be fostered in learning, including metacognition, meta-affection and metaconation. The differentiation of metacognition, meta-affection and metaconation is necessary to obtain a complete understanding of how the components interact, resulting in improving the learning process. Although, the findings in this thesis are based on a focus on metacognition as it is still ambiguous how to develop this within entrepreneurship education.

More importantly, the concept of metacompetencies and meta-abilities in learning, and how this affects the employability of the individual and his or her knowledge and skills has been included in a model that contributes to establishing a foundation for future research on how this influences entrepreneurial and enterprising learning and behaviour in students.

The author's theoretical, methodological and practical contribution through this thesis will now be described.

Theoretical and methodological contribution of the thesis

The author has contributed by developing a new approach to assessing the impact of entrepreneurship education through metacognition in students. Furthermore, the new assessment instrument, the *Measure of Metacognitive Awareness* (MMA), has been developed by elaborating the *Generalized Measure of Adaptive Cognition* (GMAC) in order to measure the level of metacognition in students participating in entrepreneurship courses.

In addition, the author has contributed to a model of metacompetencies in entrepreneurship education. While the model emphasizes metacognition and metacognitive awareness, it provides a foundation for further research regarding the other components of metacompetencies. The author states that metacompetencies are a combination of metacognition, meta-affection and metaconation, and that in order to enhance the effectiveness of entrepreneurship

education, it is necessary to increase awareness of all three components to allow students to become more employable and successful in society. The author has also contributed by providing suggestions for how to develop metacognition.

Practical contribution of the thesis

Author has identified a heterogeneity of students in terms of the two extreme groups with higher and lower levels of metacognition. Furthermore, the differences between students have been presented based on the level of studies (i.e. undergraduate and graduate), study discipline (i.e. technical and natural sciences) and gender, making it possible to provide evidence of different levels of metacognition. Information about the different level of metacognition in students makes it possible to improve entrepreneurship education at university, and change the thinking patterns of students to accommodate more enterprising elements. The author has also identified weaknesses in individual components of student metacognition, and based on this, indicated how to improve entrepreneurship education in the future. Consequently, students will become more successful when facing complex tasks in an entrepreneurial environment.

In addition, using the MMA measurement instrument contributes to widening the set of empirical tools for assessing the level of metacognition, making it possible to adjust the content of entrepreneurship education based on the strengths and weaknesses in an individual's thinking.

Limitations and future research

It is important to acknowledge the limitations of this thesis. Firstly, the new MMA measurement instrument has only been tested among students from one university because the inter-university context has not been the focus of the research. Secondly, the variety of study-disciplines has to be considered when assessing the results. Although different non-economic disciplines have been included in the empirical research, their variety should be further extended. This means that students studying creative arts, design or music could be included in the future.

In addition, it is important to continue research into metacompetencies and specifically meta-affection and metaconation based on the model proposed in this thesis. This would help increase our understanding of how to enhance entrepreneurship education and the future competitiveness of students on the labour-market.

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KOKKUVÕTE

Käesolev doktoritöö tugineb arusaamale, et lisaks erialastele teadmistele ja oskustele on tänapäeval järjest olulisem üliõpilaste motiveeritud õppimine, teadmiste kasutatavus ja metateadmine (ehk metaoskused/-võimed või metakompetentsus). Viimane tähendab isiku teadlikkust oma meelte tegevusest ja meeelseisunditest ning võimet neid kontrollida ja muuta (Gavelek ja Raphael, 1985). Selline teadmine aitab kaasa õppima õppimise võimekuse arendamisele, toetab teiste teadmiste ja oskuste motiveeritud õppimist ning ka teadmiste suuremat kasutatavust praktikas. Ettevõtluse kontekstis võimaldab isiku metakompetentsus kohaneda kiiresti väliskeskkonna muutustega ja teha õigeid otsuseid probleemide lahendamisel, ärivõimaluste avastamisel, hindamisel ja rakendamisel muutuvas väliskeskkonnas. Seega loob üliõpilaste metakompetentsuse arendamine ülikoolis eeldused lõpetanute konkurentsivõime kasvuks tööturul nii ettevõtjana kui ka ettevõtliku palgatöötajana.

Ettevõtluse kontekstis on metakompetentsust vähe uuritud, mistõttu käesolev töö täiendab ja arendab edasi seniseid uuringuid, et lisada ettevõtlusõppe arengusse uus lähtepunkt – üliõpilase metakompetentsuse arendamine. Paljud autorid on metakompetentsust vaadelnud kolme komponendina, st metakognitiivsus, metaafektiivsus ja metakonatiivsus, mis on omavahel tugevalt seotud ja toimivad koos. Metakompetentsuse kõik komponendid toetavad üliõpilaste ettevõtlikkuse ja ettevõtluskompetentsuse arendamist, mistõttu teadusuuringud selles valdkonnas on määrava tähtsusega, et arendada õppeprogramme ja –meetodeid, mis tagavad noorte spetsialistide eduka toimetuleku tööturul. Siinne uurimus alustab sellest, et keskendub üliõpilaste metakognitiivsete võimete arendamisele ülikooliõppes.

Doktoritöö toetub neljale üksteisega seotud teadusartiklile. Töö eesmärk on panustada hindamismeetodi arendamisele ettevõtlusõppe taseme tõstmiseks üliõpilaste metakognitiivsete võimete täiustamise kaudu. Selleks on autor püstitanud viis uurimisülesannet:

- 1) Arendada välja uus lähenemine ettevõtlusõppe hindamiseks ülikoolides.
- 2) Mõõteinstrumenti (küsimustiku) arendamine, et hinnata üliõpilaste metakognitiivsete võimete taset.
- 3) Ettevõtlusõppe mõju hindamine eri üliõpilasarühmade metakognitiivsete võimete ja selle teadlikkuse taseme kaudu.
- 4) Ettevõtlusõppe arendamine, et tõsta insenerierialade üliõpilaste metakognitiivsete võimeid ja suurendada nende konkurentsivõimet tööturul.
- 5) Ettevõtlikkuse ja ettevõtluskompetentsuse mudeli arendamine, et siduda see üliõpilaste metakompetentsusega õppimise kontekstis.

Uurimistöõ esitab uue lähenemise ettevõtlusõppe mõju hindamisele üliõpilaste metakognitiivsete võimete täiustamise kaudu. Selleks on kasutatud küsimustikku *Generalized Measure of Adaptive Cognition* (GMAC; Haynie 2005), mida on testitud mittemajanduserialasid õppivate üliõpilaste valimiga. Küsimustik

sisaldab 35 metakognitiivsust puudutavat väidet, mis on jaotatud viide gruppi (eesmärgipüstitus, metakognitiivsed teadmised, metakognitiivsed kogemused, valikute langetamine ning metakognitiivne kontroll ehk tulemuste monitooring).

Uurimistöö tulemused näitavad, et üliõpilased hindavad oma metakognitiivseid võimeid keskmiselt üsna kõrgeks juba õppe alguses. Üliõpilaste enesehinnang paljudele väidetele eesmärgipüstituses, saadud teadmiste ja kogemuste ning käitumuslike valikute kohta muutub aga ettevõtlusõppe käigus, mis näitab muutusi üliõpilaste metakognitiivsuses. Märgatavalt rohkem kasvasid hinnangud ülesannete eri lahenduste leidmise ja nende vahel valimise võimekuse kohta. Sarnane kasv on seotud ka tulemuste saavutamise seire võimekusega, mis tuvastab ülesande või probleemi lahendamise. Muutusid hinnangud ka ressursside kasutamise organiseerimisega seotud oskustele pärast ettevõtlusõppe läbimist, mis näitab, et neid oskusi on võimalik õppe käigus arendada. Kahtlemata mõjutavad üliõpilaste metakognitiivsust kõik vaadeldud perioodi õppeained. Töös on küsitletud üliõpilasi, kes osalesid ettevõtlusõppes, ja töö on suunatud siiski ettevõtlusõppe arendamisele, kuigi mitu uuringu tulemustest lähtuvat ettepanekut võivad sobida ka teiste ainete arendamiseks.

Bayesi võrkude analüüsimise teel saadud täiendavad tulemused näitavad, et suurimad muutused metakognitiivsete võimete struktuuris toimusid siis, kui probleeme lahendati varasemate teadmiste ja kogemuste abil. Kui ettevõtlusõppe kursuse alguses hindasid üliõpilased tulemuste saavutamise seire võimekust kõrgemalt, toetudes varasematele kogemustele, siis pärast kursust tõusis varasemate ja uute teadmiste kasutamise olulisus. Need tulemused kinnitavad, et õppe abil on võimalik mõjutada üliõpilaste teadlikkust ja võimet hinnata, kontrollida ning juhtida oma mõttetegevust ja käitumist, mis reguleerivad õppimist ja muudavad üliõpilased kohanemisevõimelisemaks ning edukamaks nii õppes kui ka tööturul.

Uurimistulemused toovad siiski välja selle, et GMAC-instrumendi rakendatavuse suurendamiseks ja täpsemate tulemuste saamiseks tuleks seda paremini kohandada nii, et seda saaks kasutada eri kontekstides ja taustaga üliõpilasarühmades. Lähtudes soovist analüüsida 280 üliõpilase tulemusi selle alusel, kuidas üksikud väited jaotuvad viie väidetegrupi vahel, on autor välja pakkunud täiustatud hindamisinstrumendi – MMA-küsimustiku (*Measure of Metacognitive Awareness*). Nimetatud instrument mõõdab täpsemalt üliõpilaste metakognitiivsust ja täiendab empiiriliste uuringute kogemust selles valdkonnas. Üliõpilasarühmade MMA-küsimustiku abil saadud tulemuste analüüs näitab, et madalamalt (nõrgemalt) hinnatud metakognitiivsusega üliõpilastel on muutused suuremad kui kõrgemalt (tugevamalt) hinnatud metakognitiivsusega üliõpilaste seas. Kahe grupi võrdluses võib enesehinnangute alusel välja tuua, et ressursside oskuslik kasutamine on problemaatiline eelkõige madalama metakognitiivsusega üliõpilaste seas. Neil jääb puudu ka võimekusest saavutatud tulemusi kriitiliselt hinnata. Samas paistavad kõrgema metakognitiivsusega üliõpilased silma oskustega seada endale arusaadavaid ja saavutatavaid eesmärke. On siiski ilmne, et üliõpilased ei ole eriti teadlikud sellest, kui tähtis on saavutatud tulemuste

tagasiulatuv hindamine (reflektatsioon) mõtlemise ja hoiakute kujundamisel. Lisaks on muutused kõrgema metakognitiivsusega üliõpilaste mõtlemises suures osas statistiliselt väheolulised. See puudutab logistikat ja loodusteadusi õppivaid üliõpilasi, millest võib teha järelduse, et kasutatav õppemetoodika pole piisavalt mõjutanud nende üliõpilaste metakognitiivsete võimete arendamist. Samas on naissoost üliõpilased hinnanud oma metakognitiivsust tugevamaks kui meessoost üliõpilased. Uuringu tulemusena selgub, et erinevus kõrgemalt ja madalamalt hinnatud metakognitiivsusega üliõpilaste vahel on ettevõtlusõppe käigus vähenenud kuni 20%. Seega on ettevõtlusõppel (ja ka teistel ainetel) vaadeldud perioodil olnud oluline mõju eelkõige madalama metakognitiivsete võimete üliõpilastele.

Järgnevalt uuriti täpsemalt kõige madalamalt hinnatud väiteid mittemajanduserialade üliõpilaste seas. Ilmnes, et ettevõtlusõppes tuleks oluliselt parendada eelkõige üliõpilaste aja ja teabe kasutamise oskusi. Siin on tähtis, et üliõpilased analüüsivad ja hindavad (sh seavad kahtluse alla) enda oletusi igast küljest enne, kui ülesannet lahendama asutakse, ja sel moel veenduvad, et saavutatakse parim tulemus. Ettevõtlusõppes peaks pöörama tähelepanu ka üliõpilaste oskustele oma tegevusi varem planeerida ja püstitatud eesmärkide saavutamist kontrollida. Tähtis on suurendada ka ülesannete hulka, mis näitavad keeruliste ülesannete osadeks jagamise teid ning selle kasulikkust probleemide paremaks lahendamiseks.

Lisaks tuleb üliõpilasi edukuse suurendamiseks suunata ettevõtlusõppes hindama valitud strateegiaid ja analüüsima, kas ülesanded on täielikult arusaadavad. Pärast ülesannete lahendamist on aga vaja tugevdada harjumust analüüsida, kas arvesse on võetud kõiki teadaolevaid ja tulemusi mõjutavaid asjaolusid. See tähendab, et ettevõtlusõpe peaks süvendama üliõpilaste oskust õppida lahendatud probleemidest. Ilma selleta ei pruugi üliõpilased piisavalt väärtustada oma metakognitiivsete võimete nõrkade ja tugevate külgede kindlaksmääramist ja nende süsteemset arendamist õppeprotsessis.

Üliõpilaste metakompetentsus, st teadlikkus ja võime hinnata, kontrollida ning juhtida oma mõtletegevust ja käitumist, on tähtis üliõpilaste ettevõtlikkuse ja nende ettevõtliku käitumise arendamisel, et suurendada nende edukust karjääriredelil pärast ülikooli lõpetamist. Töös esitatud mudel põhineb sellel, et metakompetentsuse kolm komponenti (metakognitiivsus, metaafektiivsus ja metakonatiivsus) on omavahel tihedalt seotud, toetavad ettevõtlikkuse ja ettevõtlusalase kompetentsuse arendamist ning peaks olema oluline osa ettevõtlusõppe taseme tõstmisel. Sellele aitab kaasa töös esitatud hindamismeetod üliõpilaste metakognitiivsuse kohta.

Uurimuse teoreetilise ja metodoloogilise panusena esitatakse uus lähenemine ettevõtlusõppe hindamisele ülikoolides, lisatakse ettevõtlikkuse ja ettevõtlusalase kompetentsuse mudelisse metakompetentsuse tegur ning arendatakse hindamismeetodit (küsimustikku) ettevõtlusõppe taseme tõstmiseks üliõpilaste metakognitiivsete võimete täiustamise kaudu. Kuna töö empiiriline uuring keskendub ühele metakompetentsuse teguritest – metakognitiivsusele –, siis see

võib olla aluseks teisi metakompetentsuse komponente käsitlevatele uurimustele tulevikus.

Praktiline panus väljendub MMA-küsimustiku testimises mittemajanduserialade üliõpilaste valimiga ning eri tasemega metakognitiivsete võimetega üliõpilaste gruppide tuvastamises. Lisaks on uuritud üliõpilaste metakognitiivsete võimete taseme seost õpitava eriala ja sooga. Tuvastatud on ka madalamalt hinnatud metakognitiivsed võimed (ehk üliõpilaste nõrgad küljed), mis võivad olla aluseks uute õppemeetodite kasutuselevõtmisel selleks, et tõsta ettevõtlusõppe taset üliõpilaste metakognitiivsete võimete täiustamise kaudu. Töös arendatud hindamismeetod on abiks uute õppemeetodite valikul.

Toetudes töö tulemustele, tuleks käesoleva doktoritöö autori arvates ettevõtlusõppes ja ka teistes õppeainetes kasutada traditsiooniliste õppemeetodite kõrval rohkem iseseisvat ja loomingulist mõtlemist arendavaid aktiivõppe meetodeid, samuti tagasiulatuvat hindamist (refleksioon) mõtlemise ja hoiakute kujundamisel. Need meetodid suurendavad üliõpilaste õppimise motivatsiooni ja teadmiste kasutatavust praktikas, mis omakorda suurendab nende edukust erialase karjääri ülesehitamisel.

ABSTRACT

This thesis follows the discussion among scholars about the need to enhance the level of metacompetencies in students, facilitating problem-solving, self-regulation and the ability to monitor thinking and increase success in terms of employability on the labour market. The metacompetencies in students, including skills and the knowledge of how to use them and when and why to use them, also contribute to the abilities necessary for learning to learn. With that, metacompetencies improve student learning through facilitating metacognition, meta-affection and metaconation within teaching. Hereby entrepreneurship education can make a significant contribution, as one of the goals of entrepreneurship programmes is to instil in students the importance of learning and developing metacompetencies that enhance their preparedness for an enterprising life.

This thesis focuses more on metacognition in a person and finding ways to support the development of metacognitive abilities in students in the context of learning in universities. The author has identified a gap in existing research in relation to the need to understand how to teach students to develop metacognition in order to enhance metacompetencies in learning, employability and improve their ability to adapt to the surrounding environment.

The aim of current thesis is to contribute to the development of an assessment instrument for entrepreneurship education in universities with a new approach to developing student metacompetencies that foster enterprising and entrepreneurial behaviour. The empirical research aims to reveal aspects of entrepreneurship education that contribute more to the development of metacognitive abilities and entrepreneurship competencies in students. The thesis is based on four interconnected research papers, addressing the following research tasks:

- Task1: Development of a new approach to the evaluation of entrepreneurship education in university
- Task2: Development of a measurement instrument for capturing the level of metacognition in students
- Task3: Assessment of the impact of entrepreneurship education on the metacognitive abilities and awareness of different groups of students
- Task4: Enhancement of entrepreneurship education for engineering students to increase their metacognitive abilities and employability
- Task5. Developing a model of enterprising and entrepreneurial competencies with the inclusion of metacompetencies for individuals in studies.

The current study presents a new approach to assessing entrepreneurship education at university based on changes in the metacognitive abilities of students. The research is based on the *Generalized Measure of Adaptive Cognition* (GMAC; Haynie, 2005) measurement instrument tested on a sample of students studying different non-economic disciplines.

The findings indicate that on average students have assessed their metacognitive abilities at a higher level at the beginning of the entrepreneurship courses. Still, the analysis implies that changes in terms of metacognitive abilities have occurred in students during the learning process. More specifically, the findings indicate that the abilities to identify and choose between methods for solving a problem and monitoring when the goal has been achieved present the greatest increase after the entrepreneurship course. At the same time, abilities related to organizing available resources (i.e. time and information) have remained at almost the same level. Consequently, it is possible to improve the abilities of students, increasing the monitoring of learning and thinking in different circumstances, in order to become more successful.

However, in an attempt to reveal more about the changes in learning and thinking, and to find more evidence about the applicability of the GMAC, the research findings among 280 students imply that it is necessary to modify the measurement instrument. With that, the modified instrument referred to as the *Measure of Metacognitive Awareness* (MMA), and which focuses on assessing the level of metacognition, extends the limited amount of empirical instruments available for measuring metacognition. However, there is a need to focus the research on different groups of students to better identify how to improve the learning process.

The findings show that students who present lower levels of metacognition before the course, indicate a greater than average increase compared to students who already had higher levels of metacognition. However, students with lower levels of metacognition lack resource-management skills. In addition, these students also score significantly lower in terms of assessment practices when performing tasks. Students with higher levels of metacognition have in parallel scored significantly higher in terms of the ability to set themselves understandable and manageable goals. Aside from this they are only modestly aware of the role and importance of reflection and reflective practices in developing their thinking and metacompetencies. Still, the magnitude of changes among students with higher levels of metacognition remains statistically insignificant, suggesting that entrepreneurship education influenced these students less or the teaching methods used did not support the development of their metacognition. Concerning differences on the basis of gender, the findings indicate that female students rate their metacognition higher than males. Furthermore, comparing on the basis of study-discipline, the effect on students studying logistics and natural sciences remains largely below the criteria of statistical significance.

More importantly, the results imply that the difference between groups of students with higher and lower levels of metacognition has significantly decreased after the entrepreneurship course (up to 20% depending on the component of metacognition). Therefore, entrepreneurship education has had a

significant impact especially on the thinking patterns in those students who started the course with lower levels of metacognition.

Applying the MMA measurement instrument to identify how entrepreneurship education can be developed through identifying the weakest aspects in thinking, suggests that students need more training on how to use the available time and information in the best way. It is equally important to foster the habit among students of challenging their own assumptions and questioning themselves beforehand about the requirements of the task. With that, entrepreneurship education must turn more attention to student skills for planning actions in advance, allowing to act more efficiently and systematically. It is also necessary in entrepreneurship education to increase the amount of tasks addressing the methods for and usefulness of breaking complex problems down into more manageable pieces.

To enhance the students' performance further, it is crucial to purposefully direct them to analyse the usefulness of a chosen strategy and to pause and check whether the given task has been completely understood. Furthermore, after the tasks have been completed, the students have to be asked to spend time analysing whether there was an easier way to do things or if all the options have been considered. Hence, entrepreneurship education must facilitate the students' ability to learn from already completed tasks. Without that students do not start to value the importance of identifying their strengths and weaknesses in learning.

Following this, in order to take maximum advantage of entrepreneurship education, a person should be equipped with the knowledge or awareness of his or her strengths and weaknesses in learning, leading to greater adaptability. In parallel, adaptability and identity are considered key metacompetencies related to learning. In line with that, the model of metacompetencies in learning presented in this thesis is based on the idea that there is a strong interplay between metacognitive, meta-affective and metaconative abilities. Thus, the model connects metacompetencies with the development of entrepreneurial and enterprising learning and behaviour in students.

The theoretical and methodological contribution of the thesis involves the development of a new approach to assessing the impact of entrepreneurship education. Furthermore, the MMA assessment instrument has been developed. In addition, a model of metacompetencies in entrepreneurship education has been developed. While the model emphasizes metacognition and metacognitive awareness, it provides a foundation for further research regarding the other components of metacompetencies.

The practical contribution of the thesis includes the identification of a heterogeneity in students in terms of two extreme groups with higher and lower levels of metacognition. Differences have also been presented between students based on study discipline and gender, making it possible to provide evidence of different levels of metacognition. The author has also identified weaknesses in student metacognition and suggested how to improve entrepreneurship education

in the future. Aside from this, the MMA measurement instrument helps to widen the set of tools for assessing metacognition.

It is the belief of the author that the effectiveness of entrepreneurship education can be developed by including more elements of experiential or action-learning. The enterprising behaviour of students could also be improved by incorporating more real-life hands-on experiences with practicing entrepreneurs. Coupling this with a more individual approach to designing courses provides a way to develop metacompetencies in students and facilitate their success and employability in the future.

APPENDIX 1

Venesaar, U., Ling, H., & Voolaid, K. (2011). Evaluation of the Entrepreneurship Education Programme in University: A New Approach. *The Amfiteatru Economic Journal*, XIII(30), 377-391.

EVALUATION OF THE ENTREPRENEURSHIP EDUCATION PROGRAMME IN UNIVERSITY: A NEW APPROACH

Urve Venesaar^{1*}, Hannes Ling² and Karen Voolaid³

*^{1) 2) 3)} Tallinn School of Economics and Business Administration of Tallinn
University of Technology, Estonia*

Abstract

In entrepreneurship education, the development of entrepreneurial thinking and acquiring of relevant knowledge and skills for conducting the tuition process for the development of entrepreneurial initiative are very important. Besides this, it is important to also find different ways to measure the impact of the courses. The evaluation of the educational programme is a complex matter, as the question arises – what are we measuring, what indicators should be used and how should they be measured.

The current study is an attempt to develop a new approach in the evaluation of entrepreneurship education programme in university - the assessment of entrepreneurship training results through changes in metacognitive awareness of participants. Students were asked to complete, both at the beginning and at the end of the training course, a cognitive adaptability questionnaire (by Haynie). The extent to which students reflect, think strategically, plan, recognize useful knowledge-skills and analyse/control themselves was uncovered based on the results. For analysing the changes in metacognitive awareness of respondents, both the Likert Scale and Bayesian Dependency Modelling techniques are used. A Comparison of average assessments at the beginning and at the end of the course shows a small rise. Moreover, considering the strengths of the dependencies between the most important statements of thinking process, participants present a trend of growing stronger after the training course.

Keywords: entrepreneurship education, knowledge and skills, metacognitive awareness

JEL Classification: A22, C81, L26, M53

Introduction

The role of entrepreneurship in societies has grown and entrepreneurship education is seen as a mean of raising the entrepreneurial spirit and behaviour of people. There is an increasing need to include entrepreneurship education into different levels and forms of education and entrepreneurship among students has become an important topic in universities. As a number of studies show, student interest in entrepreneurship as a career

* Corresponding author, **Urve Venesaar** - Urve.Venesaar@tseba.ttu.ee

choice is growing (Brenner et al., 1991; Fleming, 1994; Kolvereid, 1996). At the same time, the importance of entrepreneurship as a source for economic development is growing which by the opinion of policy makers can be promoted by entrepreneurship education (European Commission, 2006). Therefore entrepreneurship education is promoted and implemented into school curricula in many of the European member countries (European Commission, 2006) and the United States (Kuratko, 2005). As the education programmes can vary by schools and countries the need to develop a framework to evaluate the impact of entrepreneurship programmes have appeared a key issue in research.

In this paper an attempt is made to develop a new approach in evaluation of the impact of entrepreneurship education based on changes in students' thinking process, which may help to increase the effectiveness of entrepreneurship training courses in the future. In the article, after the conceptual framework, study design and data collection methods are covered. Following this, the results of the study are presented. The article concludes with a discussion.

1. Theoretical framework

Recent studies have tried to fill in the gaps in entrepreneurship education research, e.g. by studying changes in learners values, attitudes and intentions in terms of desirability and feasibility of starting a business (Pihkala and Miettinen, 2004; Peterman and Kennedy; 2003; Fayolle and Gailly, 2005; Volery and Mueller, 2006), by looking at the role of metacognition in training, self-regulated learning and self-regulatory skills (Haynie and Shepherd, 2007; Bryant, 2006; Ramocki 2007), and by suggesting the need for different learning environments that would entail a teaching style that is action-oriented, supports experiential learning, problem-solving, project-based, creative approach and involves peer evaluation which is close to how entrepreneurs live and learn (Jones and English, 2004; Löbler, 2006; Lengnick-Hall and Sanders, 1997; Pittaway and Cope, 2007; Collins 2006; Brătianu and Nistoreanu, 2008). At the same time, there is a related debate about the degree to which entrepreneurship can be taught, and if so, how. On the one hand, if one accepts that key attributes of entrepreneurship are based on personality traits (e.g., Stewart et al, 1999), then education and training are unlikely to have a fundamental impact because they rarely alter a person's underlying personality. On the other hand, if one accepts that entrepreneurial cognition and skills are largely acquired through experience (e.g., Neck et al, 1999); then education and training may have a significant impact on decision-making and other key aspects of entrepreneurship (e.g. Bryant 2006, 280; Tăchiciu et al, 2010),).

As Mitchell et al. (2004, p. 508) note, previous researchers in entrepreneurial cognition have investigated topics such as: (1) whether entrepreneurs' thinking patterns differ from those of non-entrepreneurs (Busenitz & Barney, 1997; Gaglio & Katz, 2001; Mitchell et al, 2002), (2) the reasons that some individuals become entrepreneurs while others do not (Simon et al, 2000), (3) the issue of why opportunities are recognized by some individuals and not others, and (4) the question of how entrepreneurs think and make strategic decisions (Busenitz & Barney, 1997; Mitchell et al, 2000; Mitchell et al., 2002). Each of these topics of investigation relates to the way that thinking affects entrepreneurial outcomes. Thus it appears, that individuals who understand the thinking patterns related to entrepreneurship — and desire to become entrepreneurs — can alter their own thinking patterns accordingly.

Metacognition refers to ‘thinking about thinking’ (Jost et al, 1998) and has been defined as “the ability to reflect upon, understand, and control one’s learning” (Schraw, 1998). In their study, Mitchell et al proposed that metacognitive thinking can be deliberately practiced in an entrepreneurial context. Further, they suggested such metacognitive thinking will lead to the creation of entrepreneurial expertise by facilitating the self-reflection, understanding and control of one’s own entrepreneurial cognitions. (Mitchell, et al. 2005).

Considering the dynamic and unstable environment of entrepreneurship, metacognition also plays a role in how people adapt to their developing and changing circumstances (Haynie & Shepherd, 2007). In their article, Haynie and Shepherd investigated the roles that metacognition and feedback-type play in facilitating cognitive adaptability: the ability to inform and adapt a previously learned decision heuristic given a dynamic task environment. Findings of the study suggested that cognitive adaptability is important in an entrepreneurial context, that metacognition does promote cognitive adaptability and thus improve performance on an entrepreneurial task. The concomitant implications of the theoretical model and empirical findings were hopeful in that metacognitive abilities can be improved by learning, thus cognitive adaptability can be enhanced and entrepreneurial performance consequently improved. Additionally, this indicates an important link between entrepreneurial education and the domain of cognition-metacognition which is investigated in this paper, considering that it is broadly agreed that aspects of self-regulation, such as self-efficacy and metacognition, play important roles in educational and entrepreneurial outcomes (Bryant, 2006; Kickul & Krueger, 2005).

Supported by this the hypothesis the following can be drawn:

H1: Outcomes of entrepreneurship training courses that intentionally aim at changing metacognitive abilities of students have a positive correlation with a student’s willingness to engage into entrepreneurial activities.

By taking a metacognitive approach to education, educators can thereby induce metacognitive thinking and thus enable students to better gain knowledge about cognition and knowledge about the regulation cognition (Schraw, 1998). Therefore, Mitchell, et al. suggest that entrepreneurship students who engage in metacognitive exercises—in the form of coached scripting exercises—will be more likely to gain entrepreneurial expertise than students who do not engage in metacognitive exercises (Mitchell, et al. 2005). According to Mitchell, the inclusion of metacognitive elements in teaching curriculum would be considered to be just as important as the content of the teaching curriculum itself; and entrepreneurship educators would then be responsible to understand how to develop such a metacognitive curriculum.

However, being able to define metacognition is not all that matters. In order to successfully adapt the full extent of metacognition, one has to be aware of the importance of it and be capable to use it in a conscious and systematic manner. It needs to be noted that results of entrepreneurship training have been assessed less through changes in metacognitive awareness of participants when compared with more traditional approaches (e.g. attitudes, intentions etc). It is so, although many scholars have investigated acquired characteristics of entrepreneurs; such as entrepreneurial cognition, which includes mental models, heuristics, intuition, and self-regulatory skills as key factors in entrepreneurship (Baron, 2004; Busenitz & Barney, 1997). Moreover, the study by Bryant was aimed at measuring and identifying relationships between three self-regulatory constructs: self-regulation,

metacognitive awareness, and entrepreneurial self-efficacy by entrepreneurs (Bryant, 2006). Results of the study suggested that educational programs should seek to nurture and strengthen the relationships between students' sense of prior success in achieving positive goals, their sense of efficacy for entrepreneurial tasks, and self-awareness of their cognitive skills. In addition, it is already known that self-efficacy and metacognition can be improved by education, training and experience (Schraw, 1998), and regulatory pride can be primed situationally (Higgins et al., 2001).

The current study aims to assess the results of entrepreneurship training through changes in metacognitive awareness of students. For that purpose a cognitive adaptability questionnaire originally developed by Haynie ("Generalized measure of adaptive cognition") was used to evaluate the awareness of the participants, to what extent they reflect, think strategically, plan, know which are useful knowledge-skills for them and analyse-control themselves. This allows to identify a research question as: Are the five dimensions of metacognitive awareness identified in the survey data?

Some explanations of results are found from the analysis of the components of the thinking process (goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice, monitoring). For measuring the changes in metacognitive awareness of respondents, both the Likert Scale method and Bayesian Dependency Modelling have been used. Results of the study should contribute to the methodology of assessing the impact and results of entrepreneurship training courses to the metacognitive awareness of students. In addition it is the aim of this paper to make a contribution to the knowledge of how to teach students with the aim of widening their metacognitive awareness. Based on this, it is possible to formulate the following hypothesis:

H2: different components of metacognitive awareness are differently influenced by entrepreneurial training.

At the same time, a number of factors may influence the development of metacognitive awareness, e.g. students' personality traits, their self-efficacy, attempt to be independent, and readiness for risk-taking, etc. Previous pilot survey has showed also, that students participating a training course (camp model) with higher intention/ motivation towards entrepreneurship showed a higher impact to the changes of their metacognitive awareness than for those students of compulsory course (Ling et al, 2009). Therefore the factor of entrepreneurial intention via assessing students's personality traits has been used also in this analysis.

2. Research methodology

2.1 Participants

During the fall semesters of 2008 and 2009, two entrepreneurship training courses were held at Tallinn University of Technology (TUT) for bachelor and master degree students in engineering-related disciplines. The final database contains the datasets of 195 individuals between 20 and 34 years of age (59.3% of the total number of respondents). The overall structure of the respondents is given in Figure no 1.

It also has to be noted that the survey was carried out among the students studying different engineering-related disciplines, i.e. students of infotechnology, applied chemistry, physics,

logistics, genetechnology, geology, mechatronics, transportation technology, product development etc were represented. This leaves us 14 engineering disciplines in total. In relation to this fact it can be said that the data retrieved are representative, since a large variety of engineering discipline students taking both bachelor and master studies have been included.

2.2 Study design

Research design has been centered on a questionnaire developed to measure metacognitive awareness. In order to find an evidence supporting hypothesis, H1, a frequency analysis has been utilized to evaluate the answers given to the respective statements. This provides the statistical properties (specifically mean and standard deviation, StDev) for each statement asked, as far as the distribution of the datapoints on the Likert scale is concerned. Additionally, analyzing these results gives an opportunity to assess whether they could be dominated by certain values or not. As a second step in the analysis of statistical properties it was designed to look at the difference of means before and after the course. This would allow extracting an indication about the impact of a training course.

In order to provide evidence of whether the subdomains of metacognitive awareness could be identified in the actual datasets, factor analysis (FA) was carried out. As using FA calls for confirming the strength of interconnections between variables, an additional correlation analysis has been implemented.

However, it does not give any indication of what is causing the actual change. For capturing more scientific evidence supporting hypotheses H2 it has been concluded to look in more details at what subdomain of metacognitive awareness is more influenced than other. In order to do so the Bayesian Dependency Modelling technique has been used. Specifically an application called B-Course (<http://b-course.cs.helsinki.fi/obc/>) has been utilized, mainly because it's a simple-to-use interface and the possibility to get necessary results in a fairly short interval of time.

2.3 Procedure

The purpose of the courses was to introduce participants with the concept of an entrepreneurial mindset and widen the horizon of the respective knowledge among students. The content of the course in entrepreneurship and business planning included lectures and exercises, solving teaching cases and writing business plans. It lasted throughout the whole semester (i.e. total 16 weeks and 48 hours).

In order to collect the necessary data samples, participants were asked to fill out a questionnaire about cognitive adaptability. It was originally developed by Haynie as a "generalized measure of adaptive cognition". The questionnaire included 35 different statements and it was asked to be filled out both at the beginning and immediately at the end of the training courses. The statements covered five distinctive areas; such as goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice and monitoring. This original questionnaire was translated into Estonian in order to avoid the possibility to get false readings due to possible misunderstanding of the text. For measuring the respective ratings a 10-step Likert Scale was introduced. Respondents were asked to

answer the statements by rating each of them on the provided scale of 1 to 10, based on their own judgment where: 1 being equal to "Not very much like me" and 10 being equal to "Very much like me"

Prior factor analysis to Pearson correlation matrixes were built up using an SPSS statistical computation package for the data collected before and after the training course. It allowed coefficients not in a range of .3 to .7 to be discarded from further statistical analysis statements. This gave an opportunity to run factor analysis using SPSS on the remaining statements for checking whether the structure of metacognitive awareness provided in the questionnaire is present in the actual survey data.

As far as the Bayesian modelling is concerned, there were two models constructed involving all of the 35 statements. These models are based on survey results collected both before and after the training courses. In order to bring more scientific content into the discussion the models are complemented with data describing both the strengths of dependencies retrieved from B-Course and the Spearman rank order correlation coefficient values retrieved from SPSS.

3. Results

3.1 Cognitive adaptability of students

Evidence supporting the initial hypothesis H1 is presented in Annex. The survey shows how cognitively adaptable are the students participating in the training course. Presented are the average ratings over all the respondents before and after the training course. Looking at these ratings it could be seen that they are located at the end of the scale "very typical of me". Higher scores on the Likert Scale means that a person is more metacognitively aware, which helps to provide cognitive adaptability, i.e. the ability to reflect upon, understand, and control one's thinking and learning. The fact that ratings are located more in one end of the 10-step scale also presents evidence that answers are dominated by higher scores (values between 7 to 10). Based on this it is not possible to expect the normality assumption to be fulfilled.

In addition, it is interesting and needful to turn attention to the standard deviation (StDev) of students' answers: the values provided are also rather high which characterises different levels of the thinking of students participating in the courses. The question arises whether entrepreneurship training can still influence students' assessments of the behavioural statements brought in the questionnaire. The other interesting aspect evident regarding standard deviation is that values tend to grow smaller after the training in the majority of cases. The trend of StDev values getting smaller suggests that after the training there has been a change in participants thinking – ratings of the statements are, more than before, concentrated around average values. Although at some level this could be considered to be the expected outcome of a group-learning process, the results retrieved do not allow to draw such conclusions without additional analysis. However the changes described suggest that the training course has had an impact to participants' metacognitive awareness – meaning they are more aware of their own thinking processes.

Analysis of the results continued with examining all of the statements in order to see if they were applicable for factor analysis (research question Q1). In order to use factor analysis for assessing whether 5 subdomains of metacognitive awareness are evident in the actual

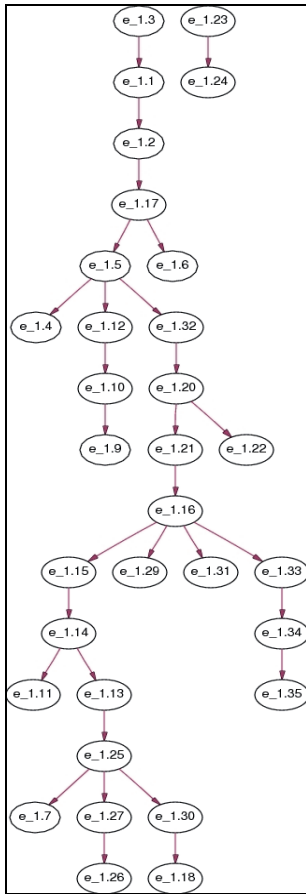
survey data, correlation coefficients were evaluated for all the statements. Based on Nokelainen (2007) the most commonly used criteria for accepting variables are, among others: (1) a standard deviation of no more than half the mean and (2) correlation between +/- .3 - .7. During the examining of all the 35 statements, both before and after the training, it was found that all of them passed the first criteria. Applying the second criteria, on the other hand, gave a result that before the training course 30 statements passed (rejecting 1.6; 1.9; 1.11; 1.23 and 1.28) and after 32 of them passed (rejecting 1.8, 1.23 and 1.28, the content of statements is brought in Annex).

Factor analysis with the principal components extraction and the varimax rotation method was conducted on the remaining statements in datasets before and after the training course. The solution provided 8 factors in both cases that did not entirely correspond to the 5 sub domains division presented in the original survey questionnaire. The fact that there is a slight discrepancy in dividing the statements according to what is described in the questionnaire could be an indication of instrumental failure. Nevertheless it can be concluded that factor analysis is indicating the presence of structure of the initial questionnaire in the general level.

3.2 Changes in students' metacognitive awareness

It was decided to use Bayesian Dependency Modelling (BDM) for both finding evidence to support hypothesis H2 and for revealing additional scientific evidence about aspects underlying the changes in students' metacognitive awareness. This was run on both complete datasets independently; ie one included datasets retrieved before the training and the other right after it. The resulting model based on the data before the training is presented in Figure no. 1 and after the training in Figure no. 2. Probability ratios in the figure indicate to which level the probability of the model would be decreased if the respective dependency is removed. Based on the order of dependencies given, ie the strongest dependencies on top and weakest on bottom of the column, it could be said that the higher position dependency has the bigger is its importance to the model in general. Spearman rank order correlation coefficient values are given for bringing complementary information into the analysis. It indicates the strength of correlation of each dependency at the level $p=.01$.

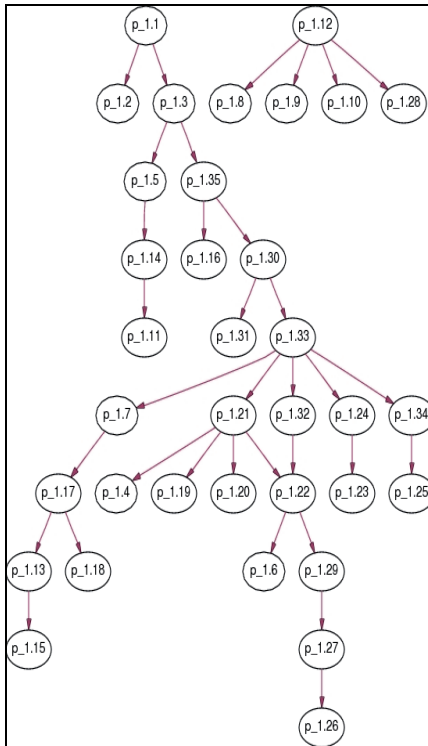
On the basis of BDM it is possible to find deeper changes among assessments of the components of students' metacognitive awareness, as well as different statements. If to take into consideration the strengths of dependencies between different behavioural statements of students before the training course, the dependencies between the most important items have in average grown stronger after the course. Although some of the stronger dependencies have weakened after the course, more changes have still occurred in the structure and the order of statements in the network model. This is also supported by the values of the Spearman rank order correlation coefficient (ie dependency between items 1.23 and 1.24. (see annex) has changed from .687 to .702; between 1.27 and 1.26 from .627 to .709; between 1.20 and 1.21 from .598 to .553)



Dependency			Probability ratio	r_s
e_1.23	-->	e_1.24		.687
e_1.20	-->	e_1.21		.598
e_1.1	-->	e_1.2		.530
e_1.16	-->	e_1.15		.434
e_1.25	-->	e_1.27		.579
e_1.5	-->	e_1.4		.515
e_1.27	-->	e_1.26	1 : 86887	.627
e_1.14	-->	e_1.11	1 : 79753	.424
e_1.10	-->	e_1.9	1 : 79573	.399
e_1.33	-->	e_1.34	1 : 68825	.488
e_1.15	-->	e_1.14	1 : 33284	.432
e_1.21	-->	e_1.16	1 : 13810	.403
e_1.32	-->	e_1.20	1 : 6684	.394
e_1.12	-->	e_1.10	1 : 2839	.314
e_1.17	-->	e_1.5	1 : 2015	.396
e_1.2	-->	e_1.17	1 : 522	.386
e_1.25	-->	e_1.30	1 : 420	.398
e_1.13	-->	e_1.25	1 : 326	.386
e_1.16	-->	e_1.33	1 : 253	.414
e_1.5	-->	e_1.32	1 : 113	.293
e_1.14	-->	e_1.13	1 : 78	.393
e_1.20	-->	e_1.22	1 : 56	.521
e_1.25	-->	e_1.7	1 : 49	.430
e_1.30	-->	e_1.18	1 : 33	.341
e_1.16	-->	e_1.31	1 : 26	.321
e_1.3	-->	e_1.1	1 : 3.57	.390
e_1.5	-->	e_1.12	1 : 1.98	.227
e_1.34	-->	e_1.35	1 : 1.88	.439
e_1.16	-->	e_1.29	1 : 1.85	.309
e_1.17	-->	e_1.6	1 : 1.27	.254

Figure no. 1: Bayesian model based on the data before the training

Note: r_s denotes Spearman rank order correlation coefficient (significant at $p=.01$)



Dependency	Probability ratio	r_s
p_1.22 --> p_1.6	1 : 838	.382
p_1.21 --> p_1.4	1 : 379	.349
p_1.1 --> p_1.2	1 : 349	.524
p_1.22 --> p_1.29	1 : 280	.372
p_1.1 --> p_1.3	1 : 252	.452
p_1.32 --> p_1.22	1 : 149	.407
p_1.17 --> p_1.18	1 : 129	.485
p_1.35 --> p_1.16	1 : 108	.271
p_1.13 --> p_1.15	1 : 78	.356
p_1.12 --> p_1.8	1 : 70	.204
p_1.21 --> p_1.22	1 : 46	.508
p_1.5 --> p_1.14	1 : 40	.317
p_1.17 --> p_1.13	1 : 25	.334
p_1.3 --> p_1.35	1 : 11	.271
p_1.33 --> p_1.24	1 : 4.4 4	.241
p_1.12 --> p_1.28	1 : 2.0 2	.211

Figure no. 2: Bayesian model based on the data after the training

Note: r_s denotes Spearman rank order correlation coefficient (significant at $p=.01$)

The results of BDM showed that the theoretical model of five domains is derived from the empirical sample from before and after the course, although considerable changes have happened between the dependencies of the different statements. This may indicate the influence of the course on the thinking process of students. Although in the importance of ranking variables (dependencies between statements) some dependencies have remained strong in both cases (e.g 1.23-1.24 in metacognitive experience, 1.26-1.27 in metacognitive choice), a number of dependencies in the network have changed; a large part of the dependencies are still rather weak.

The analysis of students' metacognitive awareness on the basis of different components in the models shows, for example, that goal orientation (item 1.5) has a significantly weak connection with the knowledge (item 1.12, see annex) domain. It shows that setting goals in the learning process is not so much related to the knowledge of metacognition, but has its

foundations in past experiences. Although the connection between these two domains remains weak after the course, there has occurred a small improvement. Based on how the items can be grouped into domains on the models, it could be concluded that domains' metacognitive knowledge and metacognitive experiences have had more change in their structure than others. Moreover it has to be noted that, for example, monitoring had dependencies before the course only with metacognitive experience, but after the course there is evidence about connections with metacognitive knowledge as well. On the other hand, it is interesting that although domain choice had connections before the course to knowledge and monitoring, the connection to knowledge disappeared after the course. It is also noticeable that the thinking process under each component became somewhat more logical and systematical after the course. Also, not all the statements under the components came out having dependencies before the course (statements 1.8, 1.19 and 1.28 were excluded from the model as independent ones), but all (100%) of the statements were included into the related model after the course. One can make a conclusion that the students' thinking process has become more substantial. The analysis is confirming that students' metacognitive awareness has been widened, and the importance of different statements has changed – which does support hypothesis H2.

For finding the evidence about factors contributing to the changes in students metacognitive awareness the students were divided into two groups based on the extent they were inclined towards being entrepreneurial. For this purpose the students were asked to fill out additional 22-item questionnaire about their psychological profile (Hisrich & Peters, 1989). Based on the models it became evident that the two groups of students are significantly different. As the model of non-entrepreneurial students includes significantly lower number of items, i.e. the statements about goal orientation (items 1-5) were missing, it is possible to conclude that the skills related to goal-setting and reflection of goals when solving entrepreneurial tasks are not significantly developed. By the contrast, at the entrepreneurial students, the items of all 5 domains in the questionnaire were present in the model. In addition as there are more items present in the second model it is possible to say that entrepreneurial students are more metacognitively aware about how they set up goals, what kind of a strategy they adopt in finding solution and at what level they are able to monitor the progress.

Discussion and Conclusion

In conclusion, the article provides an assessment of some of the results on the influence of entrepreneurship training courses on the metacognitive awareness of students. The survey showed rather high scores on the Likert Scale (7-10) of students participating in the training course, meaning that they are cognitively aware. The comparison of the average assessments at the beginning and at the end of the course shows a small rise in average assessments. Changes were more evident in the domains of knowledge and monitoring, although experience-related issues had significant importance as well. These changes confirm that after the entrepreneurship course the respondents' awareness, reflection, strategic thinking, planning, self-analysis and control have on average increased to some extent.

A Bayesian Dependency Modelling showed that the dependency between some behavioural statements has grown stronger after the course and some of them have weakened, but more

changes have occurred in the structure and importance of statements in the network model assessed on the basis of the Spearman rank order correlation coefficient. The analysis of changes among different components of the thinking process (goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice, monitoring) showed that the thinking process under each component became more systematic after the course. Therefore, the current study demonstrates a possibility to assess the results of entrepreneurship training through changes in metacognitive awareness of participants. The results of the study may help to increase the effectiveness of entrepreneurship training courses in the future.

The empirical study showed that the training course has had a varying impact to the domains of students' metacognitive awareness. Still these changes were rather modest and therefore, the inclusion of metacognitive elements into the training program would be desirable. It would provide a possibility to get a deeper knowledge about the influence of training courses, and consequently help to find better solutions for the contents and methods of entrepreneurship training courses with the aim of increasing students' metacognitive awareness. Although in order to find more scientific evidence about the recommendable content of the course, it calls for additional research in the future.

In addition - considering the fact that the 5 domain structure of metacognitive awareness model was not undeniably prominent in the empirical data might bring up the need to modify the initial questionnaire to better fit the empirical data. One also has to keep in mind that this particular questionnaire was never tested before in similar settings, i.e. as it is also referred to in this paper – it has been the first attempt to use the questionnaire for assessing the effectiveness of entrepreneurship training. It has been more an exploration for bringing new ideas and methodological aspects into the discussions of the scientific community.

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Annex Descriptive statistics, comparison of results before and after the training course

Statements	Before course		After course		Mean difference (4-2)
	Mean	StDev	Mean	StDev	
1	2	3	4	5	6
Goal orientation					
1.1. I often define goals for myself	8.1	1.494	8.3	1.303	0.2
1.2. I understand how accomplishment of a task relates to my goals	8.1	1.501	8.0	1.507	-0.1
1.3. I set specific goals before I begin a task	7.4	1.818	7.8	1.555	0.4
1.4. I ask myself how well I have accomplished my goals once I have finished	7.2	2.118	7.7	1.741	0.5
1.5. When performing a task, I frequently assess my progress against my objectives	7.3	1.938	7.6	1.714	0.3
Metacognitive knowledge					
1.6. I think of several ways to solve a problem and choose the best one	8.1	1.607	8.1	1.561	0.0
1.7. I challenge my own assumptions about a task before I begin	6.9	1.949	7.2	1.776	0.3
1.8. I think about how others may react to my actions	6.7	2.356	6.9	2.135	0.2
1.9. I find myself automatically employing strategies that have worked in the past	7.5	1.807	7.9	1.500	0.4
1.10. I perform best when I already have knowledge of the task	8.9	1.431	8.9	1.463	0.0
1.11. I create my own examples to make information more meaningful	8.1	1.762	8.5	1.622	0.4
1.12. I try to use strategies that have worked in the past	7.5	2.352	8.0	1.550	0.5
1.13. I ask myself questions about the task before I begin	6.6	2.155	7.2	1.636	0.6
1.14. I try to translate new information into my own words	7.3	2.189	7.8	1.810	0.5
1.15. I try to break problems down into smaller components	7.3	2.070	7.4	2.014	0.1

Statements	Before course		After course		Mean difference (4-2)
	Mean	StDev	Mean	StDev	
1	2	3	4	5	6
1.16. I focus on the meaning and significance of new information	7.8	1.545	7.9	1.309	0.1
Metacognitive experience					
1.17. I think about what I really need to accomplish before I begin a task	7.9	1.505	8.1	1.455	0.2
1.18. I use different different strategies depending on the situation	7.6	1.739	8.0	1.420	0.4
1.19. I organise my time to best accomplish my goals	7.4	2.143	7.4	2.073	0.0
1.20. I am good at organising information	7.3	1.699	7.5	1.493	0.2
1.21. I know what kind of information is most important to consider when faced with a problem	6.9	1.700	7.4	1.506	0.5
1.22. I consciously focus my attention on important information	7.4	2.218	7.8	1.579	0.4
1.23. My "gut" tells me when a given strategy I use will be most effective	7.0	1.987	7.3	1.942	0.3
1.24. I depend on my intuition to help me formulate strategies	7.1	1.953	7.2	2.087	0.1
Metacognitive choice					
1.25. I ask myself if I have considered all the options when solving a problem	7.2	1.843	7.4	1.822	0.2
1.26. I ask myself if there was an easier way to do things after I finish a task	7.0	2.442	7.3	2.155	0.3
1.27. I ask myself if I have considered all the options after I solve a problem	6.8	2.166	7.0	1.830	0.2
1.28. I re-evaluate my assumptions when I get confused	6.7	2.139	7.0	1.968	0.3
1.29. I ask myself if I have learned as much as I could have after I finish the task	6.3	2.164	6.8	2.155	0.5
Monitoring					
1.30. I periodically review to help me understand important relationships	7.4	1.720	7.6	1.663	0.2
1.31. I stop and go back over information that is not clear	7.6	1.827	7.9	1.719	0.3
1.32. I am aware of what strategies I use when engaged in a given task	6.4	1.818	7.0	1.687	0.6
1.33. I find myself analysing the usefulness of a given strategy while engaged in a given task	6.4	1.858	6.9	1.884	0.5
1.34. I find myself pausing regularly to check my comprehension of the problem I situated at hand	6.7	2.088	7.0	1.899	0.3
1.35. I ask myself questions about how well I am doing while I am performing a novel task. I stop and re-read when I get confused	8.4	1.631	8.3	1.521	-0.1

APPENDIX 2

Ling, H., Kyrö, P., & Venesaar, U. (2013). Entrepreneurship Education and Metacognitive Awareness: Development of a Tool to Measure Metacognitive Awareness. In A. Fayolle, P. Kyrö, T. Mets, & U. Venesaar. (Eds.), *Conceptual Richness and Methodological Diversity in Entrepreneurship Research: Entrepreneurship Research in Europe* (pp. 95-116). Cheltenham, UK: Edward Elgar Publishing.

6. Entrepreneurship education and metacognitive awareness: development of a tool to measure metacognitive awareness

Hannes Ling, Paula Kyrö and Urve Venesaar

INTRODUCTION

Development of the necessary entrepreneurial skills in students has been a focus for many entrepreneurship scholars. It has been proposed that entrepreneurial outcomes and success are affected by both cognitive (Baron, 2004) and contextual factors (Welter, 2011), along with entrepreneurial competencies involving different attitudes, knowledge and skills (Man and Lau, 2005). At the same time, findings of Henry, Hill and Leitch (2005a) share the view that entrepreneurial skills can be taught and that there exists a positive correlation between deep, strategic learning approaches and academic performance (Backhaus and Liff, 2007). Indeed, over the last decades scientific discussions concerning the ways of improving the level of entrepreneurial abilities have increasingly been related to metacognition (Batha and Carroll, 2007; Veenman et al., 2006) and metacognitive awareness (Haynie and Shepherd, 2009; Schraw, 1998). Moreover, people's increased awareness about their own thinking patterns correlates with greater success both in entrepreneurship (Ku and Ho, 2010) and academic settings (Young and Fry, 2008). It has also been proposed that students having more metacognitive knowledge perform better in the context of critical thinking (Magno, 2010). Thus, the importance of metacognition and the need to develop students' metacognitive abilities and their awareness of cognitive patterns through educational programmes has been actively studied and encouraged by entrepreneurship scholars worldwide.

Although the focus of ongoing scientific discussions is aimed to uncover the impact of metacognitive abilities in educational contexts and learning (Downing et al., 2011; Batha and Carroll, 2007), the amount of related empirical research is still rather limited. As proposed by Georghiades

(2004), this could be due to difficulties in assessing the students' metacognitive abilities or performance. Despite the fact that several instruments (tests, questionnaires) have been proposed for capturing the diverse nature of metacognition, there is still a large amount of uncertainty involved regarding the most appropriate approach for assessing the level of metacognitive abilities among students. Some instruments developed for this purpose have focused on aspects of metacognition, for example strategy use in different contexts (Mokhtari and Reichard, 2002; O'Neil and Abedi, 1996; Pintrich and de Groot, 1990) or task monitoring accuracy (Tobias and Everson, 1996). Others have focused on the regulation and knowledge domains of cognition (Pang, 2008; Schraw and Dennison, 1994). However, to a large extent the instruments are designed to consider the assessment of students' metacognitive awareness in the classroom. In this light the one developed by Haynie (2005), which draws on Schraw and Dennison (1994), is adjusted to also assess metacognition in an entrepreneurial context. Haynie's instrument incorporates goal orientation, metacognitive experiences, metacognitive knowledge, monitoring and abilities to choose between choices. Indeed, abilities needed to set the goals, adapting past experiences for present tasks, seeing different ways to solve problems and constantly monitoring the success – all play a significant role in the entrepreneurial environment. In order for an entrepreneurial person to be more successful it is important to be able to identify, utilize and consciously develop all these abilities.

In order to contribute to the assessment practices of metacognitive awareness, this study aims to test the applicability of Haynie's instrument among students with different characteristics participating in an entrepreneurship education course. Based on Haynie's study the following research questions were developed:

1. To what extent does Haynie's instrument work in the context of students with different professional and educational backgrounds?
2. How can the instrument be adapted to better assess the level of metacognitive awareness of different students participating in the entrepreneurship education course?

We show that in order to use instrument it needs to be tested and adapted to a certain environmental context. Testing the modified instrument with students from different backgrounds makes it possible to verify that the instrument is suitable to a certain extent for the assessment of the metacognitive awareness of students. A modified version of the instrument is elaborated on as a result of empirical study and referred to as Measure of metacognitive awareness (MMA), which raises the reliability

of the instrument. The current study also provides the opportunity to fill the gap in existing entrepreneurship research by extending the empirical evidence concerning the development of a measurement tool and students' self-assessments of their metacognitive awareness as well as entrepreneurship pedagogy and teaching.

Next we first define metacognition and metacognitive awareness in entrepreneurship education. Then the different assessment instruments based on these definitions are compared and the arguments for choosing Haynie's instrument are presented. This is followed by a discussion of the chosen methodology of the study and analysis of the results. At the end the research is concluded and research limitations as well as ideas for future research are provided.

THEORETICAL FRAMEWORK

Constructs of Metacognition and Metacognitive Awareness

The first definition of metacognition, the term coming from Flavell (1979), describes it as a higher order cognitive process referring to organizing what individuals know and recognize about themselves, tasks, situations and their environments. Metacognition has been identified as something referring to "the ability to reflect upon, understand and control one's learning" (Schraw and Dennison, 1994, p. 460) or "thinking about one's own thinking" (Georghiades, 2004, p. 365). Metacognition has also been identified to involve being self-aware, to think aloud, to reflect, to be strategic, to plan, to have a plan in mind, to know what you know and to self-monitor (Guterman, 2002). Anyhow, looking at metacognition from different perspectives, Schraw (1998) concludes that most researchers do agree that cognition and metacognition differ, in that cognitive skills are necessary to perform a task, while metacognition is necessary to understand how the task was performed. It can be said that metacognition plays a role in how people adapt to their developing and changing circumstances that are present in any entrepreneurial processes (Haynie et al., 2010).

But taking advantage of your own metacognitive abilities is also about raising an awareness that such abilities exist and can be developed. Schraw and Dennison (1994) developed the subject by concentrating in their research on assessment of two major components of metacognitive awareness as knowledge about and regulation of cognition. They also suggested that metacognitive awareness is something that allows planning, sequence and monitoring of the learning so that performance is improved. After all, being aware of one's own strengths and weaknesses would allow an

individual to adjust their learning in such a manner that they will become more adaptive in the context of different tasks. The same approach has been used by several other researchers (see for example Rahman et al., 2010; Young and Fry, 2008). Metacognitive awareness can in parallel be associated with information active in working memory, with social interaction, with our need to communicate our thoughts to others or to understand and judge the thinking of others (Efklides, 2008). Sheorey and Mokhtari (2001) have additionally argued for metacognitive awareness to be connected with planning and consciously executing appropriate actions to achieve a particular goal. Thus, to better understand the constructs of metacognition and metacognitive awareness we can learn from authors of previous studies about how they have interpreted the terms.

Flavell (1979) believed that monitoring of a wide variety of cognitive enterprises occurs through the actions of and interactions among four classes of phenomena: metacognitive knowledge, metacognitive experiences, goals (or tasks), and actions (or strategies). Hacker (1998) has instead divided metacognition into three types of thinking, namely: metacognitive knowledge – what one knows about knowledge; metacognitive skill – what one is currently doing; and metacognitive experience – one's current cognitive or affective state.

Henry et al. (2005b) have argued for the greater need for people to have entrepreneurial skills in order to better adapt to a changing environment and to become more self-reliant in facing the future. Supported by this there is a correlation between a person's metacognitive abilities and the level of their capacity to adapt to entrepreneurial uncertainty. In addition, it is argued that the more conscious a person is about his/her own adopted thinking patterns, the greater the chances to overcome the individual weaknesses in the cognitive processing that affect his/her behaviour under different conditions. This also correlates with the findings of Schmidt and Ford (2003) suggesting that effective engagement in metacognitive abilities is critical to enhancing learning outcomes and that people who are engaged in metacognitive activities do not necessarily work longer but spend time more effectively. The ability to consciously utilize one's own metacognitive abilities is therefore not only useful when engaging in entrepreneurial activities, as these abilities will lead to more success when faced with novel tasks also in educational settings.

Connecting to this, Efklides (2008) has uncovered the interplay between metacognition and self-regulatory skills in learning. Schraw et al. (2006) have in parallel proposed that self-regulation in learning involves a combination of cognitive strategy use and metacognitive control. Findings of Cassidy (2006) add that self-assessment skills involve the ability to monitor one's own learning and performance. Moreover, by using self-regulatory

processes students will become more self-aware, knowledgeable and decisive in their approach to learning (Zimmerman, 1990). In their recent research Haynie et al. (2010) additionally argue that foundations of an entrepreneurial mindset are metacognitive in nature. Indeed, metacognitive abilities are of great importance in developing students who are able to adapt more easily to demands of different tasks.

Haynie and Shepherd (2009) have introduced a concept of cognitive adaptability of a person as an ability to effectively learn a feedback from the environmental context in which cognitive processing happens. In order to explain the concept of metacognition, Haynie and Shepherd (2009) have employed a metacognitive theory, which, according to Schraw and Moshman (1995), integrates one's knowledge about cognition and regulation of cognition. Based on this and building on previous findings, Haynie and Shepherd (2009) have conceptualized metacognition's five theoretical dimensions as goal orientation, metacognitive knowledge, metacognitive experience, metacognitive control, and monitoring. They have proposed that *goal orientation* is an extent to which the individual interprets environmental variations in light of personal, social and organizational goals. Moreover, goal orientation serves to engage both metacognitive knowledge and metacognitive experience. *Metacognitive knowledge*, for its part, defines to what extent a person is relying on already known information when engaging in the process of generating multiple decision frameworks focused on interpreting, planning and implementing goals. *Metacognitive experience*, similarly, indicates the degree to which an individual relies on past experiences and intuitions when generating different decision frameworks. According to the conceptualization of Haynie and Shepherd, the process, involving selecting of the best, most suitable cognitive plan of action from multiple available ones, concerns *metacognitive choice* and using feedback for re-evaluating goals, metacognitive knowledge, experiences and choices, subsequently *monitoring*.

The current research builds on the approach of Haynie and Shepherd, suggesting that metacognition can be considered as a continuous process affecting the way one pursues goals, that is behaves. Behaviour of a person is also affected by the environment. Under dynamic circumstances it is important to be able to switch quickly between multiple tasks presented by rapidly changing environmental conditions. By failing to do so the person becomes unadaptable and is eventually unable to utilize their full potential. This is important not only in the university environment and related learning processes; individuals are also able to take advantage of their self-analysis skills and create an awareness of thinking in career building and in their personal lives in general. In this regard it becomes irrelevant if a person is planning to pursue an entrepreneurial (independent) career or to

work for someone else. In either case they will be more successful by being able to monitor themselves and adapt any steps according to the changed environment.

Considering the importance of the development of metacognitive awareness in students through entrepreneurship courses in the curricula, an appropriate assessment tool would help to collect information about the level of different components of metacognitive awareness; this knowledge can be a base for planning training courses according to the needs explained above.

ASSESSMENT OF THE LEVEL OF METACOGNITIVE AWARENESS

There are multiple instruments developed aiming to capture different aspects of metacognitive awareness in terms of: text comprehension (Mokhtari and Reichard, 2002); task monitoring (Tobias and Everson, 1996); knowledge regulation (Haynie, 2005; O'Neil and Abedi, 1996; Schraw and Dennison, 1994); or students' performance (Pang, 2008) (Table 6.1). Moreover, the instrument compiled by Pintrich and de Groot (1990) establishes the connection between increased self-efficacy of a student and the level of learning strategies as an indicator of increased awareness.

Different instruments have largely adopted a self-assessment approach, although the results might be potentially influenced by either under- or over-confidence of respondents, potentially leading to ambiguous outcomes. In the literature it has been suggested that in terms of intellectual and social tasks, self-assessed levels of metacognitive abilities might be overestimated by low-achieving respondents and similarly underestimated by high-achieving ones (Ehrlinger et al., 2008; Langendyk, 2006). Nevertheless, as explained by Schraw and Dennison (1994), self-assessment has been adopted because from a teacher's point of view there is a need to identify metacognitively aware persons in a quick and reliable manner that in its turn calls for quantifiable results.

Metacognitive awareness inventory (MAI), developed by Schraw and Dennison (1994), includes 52 statements developed specifically for the purpose of studying metacognitive awareness in the university contexts, that is among students. This instrument measures metacognitive awareness in the frame of eight components categorized into two groups: knowledge and regulation of metacognition. The fact that this instrument covers different components of metacognition, requires a fairly low administering effort and is relatively simple, explains partially its wide usage among

Table 6.1 *Metacognitive awareness assessment instruments*

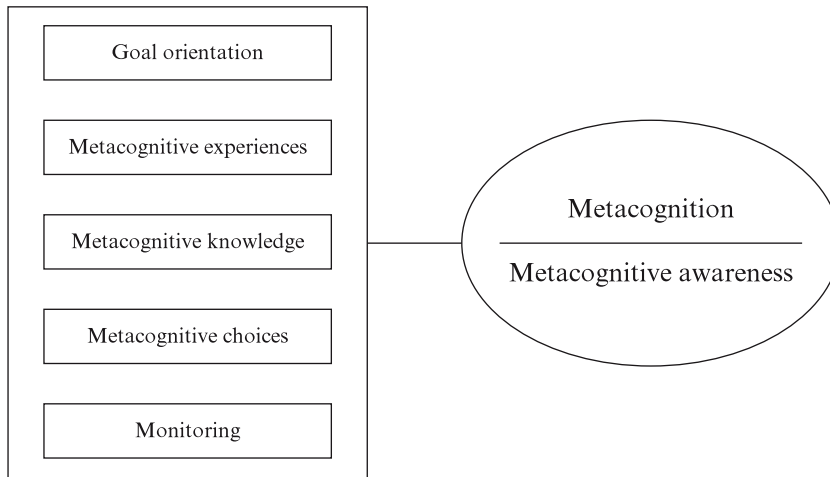
Full name	Short name	Characteristics	Year	Authors	Empirical contribution and results
1	2	3	4	5	6
Motivated Strategies for Learning Questionnaire	MSLQ	Self-reported, (56 items)	1990	Pintrich and de Groot	Sample 173 high-school students; higher level of self-efficacy correlates with higher level of learning strategies
Metacognitive Awareness Inventory	MAI	Self-reported, (52 items)	1994	Schraw and Dennison	Sample 197 undergrad. students; knowledge and regulation domains of metacognition identified
Knowledge Monitoring Assessment	KMA	Self-reported, (text comprehension tasks)	1996	Tobias and Everson	Sample 169 freshmen students; task monitoring accuracy as a measure of MC knowledge
State Metacognitive Inventory	SMI	Self-reported, (20 items)	1996	O'Neil and Abedi	Sample of 219 college students; MC abilities in the frame of planning, monitoring, strategy use and awareness, validity confirmed
Metacognitive Awareness of Reading Strategy Inventory	MARSI	Self-reported, (30 items)	2002	Mokhtari and Reichard	Sample of 825 high-school students; MC awareness assessed in frame of reading exercises
Generalized Measure of Adaptive Cognition	GMAC	Self-reported, (35 items)	2005	Haynie	Sample of 73 entrepreneurs and 432 students, MC awareness assessed in five categories; higher value correlates with greater adaptability
Metacognitive Expertise – Assessment Tool	ME-AT	Self-reported, (50 items)	2008	Pang	Sample of 114 undergraduate students; results used as a predictive measure of academic achievement

Source: Authors' compilation.

entrepreneurship scholars. In addition, several scholars have confirmed its fairly high reliability. Indeed, MAI has been used in different contexts. For example, it has been found that the level of metacognitive awareness correlates with students' grades or performance (Batha and Carroll, 2007; Young and Fry, 2008) and with the level of their self-confidence (Kleitman and Stankov, 2007). Some other studies have found that the gender of students does not have a significant influence on the level of metacognitive awareness (Memnun and Akkaya, 2009; Stewart et al., 2007).

While a majority of instruments are focused on university contexts, Haynie has developed a metacognitive assessment tool, Generalized Measure of Adaptive Cognition (GMAC) applicable in the contexts of both universities and entrepreneurship. This means that Haynie built his instrument for measuring metacognitive awareness of students and entrepreneurs. This approach seems to be valid among entrepreneurs whose success or failure depends to a large extent on the degree of adaptability with fast-changing surroundings. Furthermore, besides entrepreneurs aiming to grow the company and take advantage of business opportunities, adaptability with the environment also plays a significant role for students, particularly for the potential entrepreneurs. By developing cognitive adaptability with their surroundings the student extends the potential to understand new material in an easier way, to become more flexible about different study strategies and their implementation. An adaptable student is less likely to use only one study strategy repeatedly but instead deliberately and consciously seeks for new ways aiming to improve their performance. This correlates with aims of entrepreneurship training in terms of increasing a student's propensity to become more self-reliant and to be engaged in new innovative activities. Moreover, this seeks to contribute to achieving the ultimate goal of entrepreneurship training that is making an impact on students' attitudes and intentions towards entrepreneurship, that is developing a more positive approach towards entrepreneurship and becoming more interested in starting an entrepreneurial career in the future. In this context both entrepreneurs and students wanting to become more successful need to adapt similar cognitive processing and develop an awareness of such processes.

Therefore, in principle, Haynie's tool for measuring cognitive adaptability of individuals fits well with the current research as the target group of the study are students participating in courses of entrepreneurship education. This connects our study with Haynie's approach, based on which a model involving five theoretical components of metacognition and a metacognitive awareness instrument have been constructed (Figure 6.1). By testing the GMAC instrument it could give information about to what extent the five components and the related variables (in Haynie's instrument) describe the level of students' metacognitive awareness with



Source: Authors' adaptation based on Haynie and Shepherd (2009).

Figure 6.1 Research model connecting metacognitive awareness assessment instrument with metacognition

sufficient accuracy. Moreover, this also allows us to see how the instrument might be developed further in order to adapt it better within the context of entrepreneurship courses in the university.

DATA AND METHOD

Empirical evidence was collected from the respondents in Tallinn University of Technology (Table 6.2). The authors worked with two samples: the first one included a dataset of 280 students from several disciplines taking part in a compulsory entrepreneurship training course in a three-year period between 2008 and 2010. The courses lasted throughout the whole semester involving lectures, different practical exercises and solving teaching cases using the business planning approach. This means that a more traditional approach to teaching entrepreneurship was applied (Hytti and O'Gorman, 2004).

Three categories were constructed from the various disciplines: technical sciences (information technology, mechatronics, transportation technology, product development and production engineering); natural sciences (chemistry, physics, gene technology, geology); and logistics. In addition, students from both undergraduate and graduate studies were involved.

Table 6.2 Characteristics of the samples

	Count N	Male (%)	Female (%)	Total (%)
1	2	3	4	5
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
Technical sciences	140	83.6	16.4	100.0
Natural 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 second sample includes datasets of 79 respondents who participated in short and very intensive (24 hours without a break) entrepreneurship training during 2009 and 2010. The purpose of the course was to write a business plan, and in addition it also provided a number of training hours with the aim of developing creativity, innovative thinking, self-assessment skills and supporting teamwork necessary for entrepreneurial undertakings. These courses were voluntary and students were motivated to learn more about entrepreneurship.

The first sample contains more graduates than undergraduate students in different disciplines. At the same time, the second sample includes students studying mostly at the undergraduate level. Furthermore, most of the students in both samples were male, except among those studying natural sciences in the first sample, of which the majority (75.3 per cent) were females.

For the purpose of testing the presence of five components of metacognition and to answer the first research question, an original GMAC instrument was used, as proposed by Haynie. This instrument included 35 different statements covering all five areas of metacognition. The questionnaire was translated into Estonian in order to minimize the likelihood of receiving false readings because of misunderstanding of the text. The respondents were asked to answer the statements by rating each of them on the Likert scale of 1 to 10, where 1 indicated "Not very much like me" and 10 was "Very much like me".

In order to answer the second research question concerning the adoption of Haynie's instrument to assess the level of metacognitive awareness of students, a confirmatory factor analysis was conducted. As pointed

out by scholars, factor analysis relies on linear correlation between variables (Hinton et al., 2004) and if properly executed, begins with examining the correlation coefficients between the variables that are being studied (Comrey and Lee, 1992). The factor analysis helps to test the instrument and shows how the variables will be distributed between the factors (components). The lower and upper limits of correlation coefficients allowing the statements to be included in the factor analysis were chosen as $\pm .3$ and $\pm .7$ respectively. Thus the statements below $\pm .3$ or above $\pm .7$ were considered eligible for removal from the analysis. The factor analysis was conducted using maximum likelihood analysis with oblique, promax rotation. This ensures that estimates converge quickly and also possible correlation between factors has been considered (Haynie and Shepherd, 2009).

In the second step of analysis, the goal was to test the modified instrument in order to evaluate the impact of modifications in the frame of metacognitive awareness. The results of the analysis can help us verify whether the instrument is suitable for the assessment of the metacognitive awareness of students participating in the entrepreneurship education course. Furthermore, this helps to solve the second research question of the study about the adoption of the instrument to better assess the level of metacognitive awareness of different students.

The findings of the two research questions, providing a contribution to metacognitive awareness assessment practices in the frame of entrepreneurship education, will be discussed in detail in the next section.

RESULTS

The original GMAC instrument includes 35 different statements that are divided between five components covering goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice and monitoring.

Based on the results of confirmatory factor analysis and calculated correlation coefficients for the statements and the strengths of dependencies, six statements were applicable for exclusion. Three of them involved the metacognitive knowledge component, two with metacognitive experience and one with metacognitive choice. The discarded statements indicate that other people's reactions ("I think about how others may react to my actions"), automatic employment of past strategies ("I find myself automatically employing strategies that have worked in the past"), confusion handling ("I re-evaluate my assumptions when I get confused") and meaningfulness of information ("I create my own examples to make information more meaningful") are independent from the rest of the

statements. It is possible that for students' understanding of information, the meaning of the information is considered less important than just completing the task at a required level, meeting the expected criteria. Hence they might also prefer to follow instructions given by others rather than to pursue their own strategies so that the risk of failure is minimized. Furthermore, it is interesting that the statements involving gut-feeling ("my 'gut' tells me when a given strategy I use will be most effective") and intuition ("I depend on my intuition to help me formulate strategies") have also been excluded from the analysis based on the datasets of the first sample. Although intuition is important for entrepreneurs it might be that students do not utilize it when engaged in entrepreneurial tasks. They might also feel so confident in their abilities that intuition is not considered important. On the other hand, exclusion of these statements might also be affected by a more general cultural environment which supports individualism. Therefore students might also not consider others' reactions and feelings as very important to them.

For the remaining 29 items the factor analysis resulted in classifying the statements coinciding with the general structure of the components of metacognitive awareness, although the structure of variables inside the components has been changed. Factor loadings conducted with maximum likelihood analysis and promax rotation with Kaiser's normalization provided the loadings of individual statements as seen in Table 6.3. In this table the loadings greater than .3 have been reported so that cross-loadings are also apparent. Thus after thoroughly examining the individual factors, it becomes evident that in total eight statements have been classified differently among the five components than are proposed with the GMAC instrument. In order to distinguish the GMAC instrument before and after the applied changes, the modified version of it is referred to as a Measure of Metacognitive Awareness (MMA). The validity of the modified instrument can be proved via thorough analysis of the meanings of the statements reordered.

First, by looking in detail at these eight statements we can see that based on their inherent characteristics the classification has improved. For example, the statement "I think of several ways to solve a problem and choose the best one" belonged according to GMAC to the metacognitive knowledge component, but was regrouped into metacognitive choice instead (Table 6.4). Thinking about different solutions to a problem also requires knowledge about own reasoning, meaning that the statement involves both an ability to make choices (i.e. metacognitive choice) and knowledge about oneself (i.e. metacognitive knowledge) in order for the task to be achieved.

Metacognitive knowledge is related to one's abilities to utilize existing

Table 6.3 Factor loadings between statements of the instrument measuring metacognitive awareness (MMA)

	Goal orient.	MC exp.	MC choice	Monitoring	MC know.
	2	3	4	5	6
1					
2. I understand how accomplishment of a task relates to my goals	.81				
1. I often define goals for myself	.78				-.31
3. I set specific goals before I begin a task	.73				
4. I ask myself how well I have accomplished my goals once I have finished	.57				
5. When performing a task, I frequently assess my progress against my objectives	.54				
17. I think about what I really need to accomplish before I begin a task	.47				
19. I organize my time to best accomplish my goals	.37	.30			
20. I am good at organizing information		.99			
21. I know what kind of information is most important to consider when faced with a problem		.78			
22. I consciously focus my attention on important information		.62			
32. I am aware of what strategies I use when engaged in a given task		.44			
18. I use different strategies depending on the situation		.36			
27. I ask myself if I have considered all the options after I solve a problem			.96		
26. I ask myself if there was an easier way to do things after I finish a task			.81		
25. I ask myself if I have considered all the options when solving a problem			.56		
6. I think of several ways to solve a problem and choose the best one			.29		
35. I ask myself questions about how well I am doing while I am performing a novel task. I stop and re-read when I get confused				.74	
34. I find myself pausing regularly to check my comprehension of the problem situated at hand					.67

Table 6.3 (continued)

	Goal orient.	MC exp.	MC choice	Monitoring	MC know.
1	2	3	4	5	6
31. I stop and go back over information that is not clear				.56	
10. I perform best when I already have knowledge of the task				.48	
33. I find myself analysing the usefulness of a given strategy while engaged in a given task				.47	
12. I try to use strategies that have worked in the past				.28	
14. I try to translate new information into my own words				.83	
13. I ask myself questions about the task before I begin				.67	
15. I try to break problems down into smaller components				.67	
29. I ask myself if I have learned as much as I could have after I finish the task				.30	
7. I challenge my own assumptions about a task before I begin				.30	
16. I focus on the meaning and significance of new information		.30		.30	
30. I periodically review to help me understand important relationships				.25	

Notes:

1. Maximum likelihood extraction method with promax rotation and Kaiser normalization has been used.
2. The numbers of statements refer to the ones used in the GMAC questionnaire.

Source: Author's compilation.

Table 6.4 Reordering of statements between GMAC and MMA based on the first sample

Statement	Component of assessment instrument	
	GMAC	MMA
1	2	3
I think of several ways to solve a problem and choose the best one	Metacognitive knowledge	Metacognitive choice
I perform best when I already have knowledge of the task	Metacognitive knowledge	Monitoring
I try to use strategies that have worked in the past	Metacognitive knowledge	Monitoring
I think about what I really need to accomplish before I begin a task	Metacognitive experience	Goal orientation
I organize my time to best accomplish my goals	Metacognitive experience	Goal orientation
I ask myself if I have learned as much as I could have after I finish the task	Metacognitive choice	Metacognitive knowledge
I periodically review to help me understand important relationships	Monitoring	Metacognitive knowledge
I am aware of what strategies I use when engaged in a given task	Monitoring	Metacognitive experience

Source: Authors' compilation.

knowledge in order to make new information cognitively more meaningful. Haynie and Shepherd (2009) have in parallel proposed that metacognitive knowledge relates to an extent to which a person relies on what is already known about themselves, other people, tasks, and strategies. Nevertheless, this statement is not only about thinking of different strategies based on the level of our knowledge; it relates even more to an ability to choose between different existing cognitive strategies. At the same time, metacognitive choice is about utilizing an ability to construct and visualize possible paths in moving toward the set of targets, and choosing between them so that existing knowledge will be fully employed. Haynie (2005) has indicated that generating alternative ways to create cognitive strategies and choosing among them is a choice of a metacognitive nature. Based on that, metacognitive choice involves a level of active engagement in selecting from multiple strategies and it justifies the inclusion of this particular statement in the metacognitive choice component instead.

The statements “I perform best when I already have knowledge of the task” and “I try to use strategies that have worked in the past” also involve

metacognitive knowledge. However, the more extensive knowledge a person has in advance about the task the higher is the possibility that the task will be achieved by using automatic cognitive responses. This means that actual metacognitive knowledge might not be engaged to the extent expected. Considering the nature of the statements it can be proposed that instead of utilizing metacognitive knowledge, the monitoring abilities will be used more. After all, monitoring does involve an ability to utilize feedback in order to reconfigure and adapt already existing knowledge into used strategies. It is also confirmed by other studies that metacognitive monitoring allows the entrepreneur to reflect how, why and when to use certain strategies (as opposed to others), given a changing environment and his or her own motivations (Haynie et al., 2010). Following this, the statements should be included in the monitoring component instead.

The statements “I think about what I really need to accomplish before I begin a task” and “I organize my time to best accomplish my goals” have according to GMAC been classified in the metacognitive experience component. Metacognitive experience is proposed to explain the degree to which a person is able to take advantage of his/her past cognitive experiences when faced with new circumstances. When looking into the nature of these statements they are indeed related at some level to past experiences of a person. It is likely to be impossible to organize one’s own steps in moving successfully towards goals without being supported and taking advantage of reasoning patterns used in earlier similar situations. Nevertheless, the focus of the statements refers to goal-setting abilities which will essentially activate both metacognitive experiences and metacognitive knowledge of a person. Referring to Efkides (2009), goal orientation involves strategies such as asking oneself questions about the requirements of the task, comprehension, about possible contradictions, and missing information that hinder understanding of the task. Based on these statements it is appropriate that the two statements fit better into the goal orientation component of metacognition.

In a similar manner, when looking at the statement “I ask myself if I have learned as much as I could have after I finish the task”, it is connecting to an ability to adopt the results of a task with existing knowledge so that similar tasks will be solved more efficiently in the future. According to the GMAC assessment instrument, the statement has been grouped under metacognitive choice, but adoption of new knowledge with existing knowledge heuristics and decision-making strategies would address the metacognitive knowledge component instead. Isaacson and Fujita (2006) support this by establishing a connection between higher level of metacognitive knowledge and increased ability to question yourself (that is to reflect) about task outcomes.

The statement “I periodically review to help me understand important relationships”, initially belonging to the monitoring component of metacognition, involves to an even larger extent abilities related to the constructing new relationships and new knowledge. Zimmerman (1990) has similarly suggested that successful monitoring of learning outcomes requires the presence of sophisticated reasoning processes. This refers to the metacognitive knowledge component focused on increasing the level of own knowledge about tasks, people and strategies.

As far as the statement “I am aware of what strategies I use when engaged in a given task” is concerned, it is suggested by the GMAC instrument that it belongs in the monitoring component. However, awareness of different strategies has an additional dimension in terms of a connection with past cognitive experiences. The metacognitive experiences serve as a basis for allowing a person to build more effective strategies for different tasks. Based on this, the inclusion of the statement in the metacognitive experiences component is justified. As Haynie and others (2010) expressed, knowledge and experiences can only be characterized as metacognitive in cases where the individual has an awareness of how that knowledge or experience relates to formulating a strategy to process the task at hand.

The argument supporting reordering of the above-mentioned eight statements is also evident from the scale of reliability values that indicate a slight increase when comparing the respective components of GMAC and MMA (Table 6.5). Factor analysis conducted on the first sample based on the GMAC configuration of statements explained 53.7 per cent of total variance and maximum likelihood analysis with promax rotation, resulting in a Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy of .827. When the same parameters were calculated using the first sample and the set of statements provided by MMA, the five factors explained as much as 64.9 per cent of total variance, indicating a small increase. This means that the classification of individual statements into components has improved on average. Based on the evidence provided in this table, the Cronbach alpha value of .80 for the goal orientation component represents increased reliability of the modified seven-item component of MMA. At the same time, the alpha value of the original five-item component of metacognitive choice is also increased (initial alpha of .70 compared to the .74). However, the reliability of the monitoring scale slightly decreases after the modifications (initial alpha of .76), although the alpha value of .72 remains at an acceptable level.

In addition, the configuration of MMA has also been tested with the second sample. The results indicate that KMO has remained on a similar level (.787). But even more important is that Cronbach alpha values have

Table 6.5 Reliability parameters of GMAC and MMA assessment instruments

Item	First sample		Second sample
	GMAC	MMA	MMA
1	2	3	4
Kaiser–Meyer–Olkin (KMO)	.827	.849	.787
Cronbach Alpha			
Goal orientation	.77	.80	.81
Metacognitive knowledge	.73	.76	.82
Metacognitive experience	.76	.76	.82
Metacognitive choice	.70	.74	.79
Monitoring	.76	.72	.72
Goodness of fit			
χ^2 / df	2.16	1.91	1.37

Source: Authors' compilation.

not decreased, and goal-orientation (.81), metacognitive experience (.82) and metacognitive knowledge (.82) present the highest values. Besides this, the increase compared to the initial GMAC instrument is also large. Based on these calculated reliability values and the respective changes, a conclusion can be drawn that the modifications made to the original GMAC assessment instrument increased the overall reliability of the instrument.

Moreover, the “goodness of fit” of a five-factor model as assessed by the ratio of chi-square relative to degrees of freedom means that the division of statements between the five factors is statistically reliable at the significance level of .000. The values less than 5 are considered as an indication of good model fit. As a result, the modified MMA instrument is assumed to be statistically valid for assessing the level of metacognitive awareness.

The results of the analysis have shown that the tested MMA instrument can be used for assessing the level of metacognitive awareness of students and its components in the university context. Nevertheless, the context in which it is applied has to be clearly identified and considered in explaining the results of the research.

CONCLUSIONS AND DISCUSSION

The importance of assessing the level of metacognitive awareness of an individual builds on several aspects. For example it has been acknowledged

by multiple studies that enhanced awareness about the level of one's cognitive processing affects the degree of adaptability of an individual to their changing circumstances. This essentially has an effect on the individual's success in a modern world. Furthermore, metacognitive abilities play a role in every aspect of human life in general, making it possible to identify one's own strengths and weaknesses. Raising awareness of this allows an individual ultimately to adjust their behaviour so that weaknesses can be strengthened. This becomes especially important when faced with different tasks in unfamiliar circumstances, which also concerns the uncertain environment in which entrepreneurs operate. Moreover, it has been found that metacognitively active individuals spend time more effectively (Schmidt and Ford, 2003). But ability to utilize one's own metacognitive abilities is useful not only when engaging in entrepreneurship and entrepreneurial activities; it also leads to more success in educational settings. Entrepreneurship training in universities has been widely accepted as a source of future entrepreneurs whose success depends on the degree of adaptation to their surroundings and increased self-reliance regarding their knowledge and skills. Therefore the development of a tool for measuring the metacognitive awareness of students is important for the better understanding of students' thinking and self-assessments. This will help in improving the content and teaching methods of courses that aim to increase the level of metacognitive awareness of students.

The purpose of this research was to contribute to the assessment practices of metacognitive awareness by testing the applicability of an instrument developed by Haynie and referred to as the Generalized Measure of Adaptive Cognition (GMAC). This tool was chosen for testing and in the current research the target group were students participating in a course of entrepreneurship education. In this process, the questions were raised regarding the extent to which an instrument can be used and how it could be modified in order to improve the assessment accuracy.

The results of the research allow us to draw the conclusion that in order to use the advanced form of Haynie's instrument to measure metacognitive awareness of students in different contexts it needs to be tested and adapted to a certain environmental context. Testing of the instrument with students from different backgrounds makes it possible to verify that Haynie's instrument is suitable to a certain extent to assess metacognitive awareness of students participating in courses of entrepreneurship education. But according to the results of the confirmatory analysis and based on the correlation coefficients calculated for the statements and the strength of dependencies, certain changes in the structure of the instrument were required. A modified version of the instrument is elaborated on as a result of empirical study and referred to as the Measure of

Metacognitive Awareness (MMA), which increases the reliability of the instrument for measuring the metacognitive awareness of the target group. The current study provides the opportunity to fill the gap in the existing entrepreneurship research by extending the empirical evidence concerning the development of a measurement tool and students' self-assessments of their metacognitive awareness.

This contribution to the development of metacognitive awareness measurement practices will generate more research in the future, aiming to use the instrument to better understand the impact of entrepreneurship education on students' metacognitive abilities. Finally, a tool for measuring the metacognitive awareness of students is contributing to the development of entrepreneurship pedagogy and teaching programmes.

Concerning the research limitations, there are several aspects that should be taken into account when interpreting the findings of this research. Based on the fact that Haynie's GMAC instrument was proven to be suitable only to a certain extent for the measurement of metacognitive awareness of students in the context of the current study, it is also important to test this instrument empirically in other environmental contexts. In addition, the use of only a quantitative measurement tool does not allow the evidence to be explained entirely; a qualitative survey is needed as an additional tool as it is likely that there are more latent variables affecting the results than are covered in this study. Finally it seems to us that now this instrument focuses clearly on metacognitive aspects, which means that there is also a need to create an additional instrument to catch the conative and affective aspects of meta awareness.

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APPENDIX 3

Ling, H. (2013). Impact of Entrepreneurship Education on Students' Metacognitive Awareness: Analysis Based on Students' Self-assessments. In G. Prause, U. Venesaar, & W. Kersten (Eds.), *International Business - Baltic Business Development* (pp. 265-289). Frankfurt am Main: Peter Lang GmbH.

Impact of Entrepreneurship Education on Students' Metacognitive Awareness: Analysis Based on Students' Self-assessments

Hannes Ling¹

Abstract

The importance of metacognition and the need to develop students' metacognitive abilities and their awareness of cognitive patterns through educational programs has been actively studied and encouraged by entrepreneurship scholars worldwide. However, there is not enough empirical evidence about how metacognition and cognitive adaptability could be considered in the teaching process. In order to contribute to this the aim of the current paper is to assess on the basis of empirical study the role of entrepreneurship education in the development of metacognitive awareness of students. The contribution of this study to scientific discussion involves presenting an assessment and analysis of the level of metacognitive awareness and its changes during the study of students with different backgrounds in the context of entrepreneurship education courses. The analysis revealed certain aspects of metacognitive awareness that necessitate consideration for improving the content of training courses.

Keywords: entrepreneurship education, students, metacognitive awareness

JEL classification: L26, J24, M13

1. Introduction

The question of how to prepare students for better adapting their knowledge through learning tasks in order to develop the necessary entrepreneurial skills is a focus for many scholars. Findings of past research have shown that success of a person is affected by entrepreneurial competencies (Man and Lau 2005) which, involving different skills and attitudes, can be taught (Henry, Hill and Leitch 2005a). Researchers have been advocating also for the connection between improved levels of entrepreneurial skills and both metacognition (Batha and Carroll 2007; Veenman, Van Hout-Wolters and Afflerbach 2006) and metacognitive awareness (Haynie and Shepherd 2009; Schraw 1998). It has been established that increased awareness of a person about its thinking patterns promotes greater success both in entrepreneurship (Ku and Ho 2010) and academic settings (Young and Fry 2008). Adding to this, it has been proposed that students having more metacognitive knowledge perform better in the context of critical thinking (Magno 2010).

I Tallinn School of Economics and Business Administration of Tallinn University of Technology

As regards engineering education or other specialities, Hytti and O’Gorman (2004) have argued that for a successful career it is needed to have not only outstanding professional knowledge in a specific area but also more interdisciplinary skills and attitudes are of great importance. This supports the notion that in order to become successful, either as an entrepreneur or when working for someone else, it is vital to develop metacognitive abilities. Consequently, the need to develop students’ metacognitive abilities and their awareness of cognitive patterns through educational programs has to be encouraged with entrepreneurship training programs worldwide.

The focus of on-going scientific discussions has been largely on uncovering impact of metacognitive issues both in educational contexts and learning (Batha and Carroll 2007; Downing, Ning and Shin 2011). However, there is only limited amount of related empirical research available thus generating uncertainty regarding the most appropriate approach for assessing the level of metacognitive abilities among students. Georghiades (2004) has suggested this could be caused by difficulties in assessing the students’ metacognitive abilities or performance.

Some instruments developed for this purpose have focused on aspects of metacognition, e.g. strategy use in different contexts (Mokhtari and Reichard 2002; O’Neil and Abedi 1996; Pintrich and de Groot 1990) or task monitoring accuracy (Tobias and Everson 1996). Others have focused on the regulation and knowledge domains of cognition (Pang 2008; Schraw and Dennison 1994) in the classrooms. Haynie (2005), drawing on Schraw and Dennison (1994), adjusted the instrument for assessing metacognition also in an entrepreneurial context. Haynie’s instrument incorporates goal orientation, metacognitive experiences, metacognitive knowledge, monitoring and abilities to choose between choices. Indeed, abilities related to setting the goals, adapting past cognitive experiences for present tasks, seeing different ways to solve problems and constantly monitoring the success all play a significant role for entrepreneurs in the continuously changing and uncertain business environment. The same abilities are also important for individuals within existing organisations. Allowing any entrepreneurial person to be more successful it is important to be able to identify, utilize and consciously develop all them.

Previous research works have shown that metacognitive awareness has implications for the pedagogy of entrepreneurship and teaching in general, and that these implications can be realized given that research has repeatedly demonstrated that metacognition can be taught, and cognitive adaptability enhanced (Mevarech 1999; Nietfeld and Schraw 2002; Schmidt and Ford 2003). Haynie and Shepherd have concluded that the concomitant consideration of cognitive adaptability in the design of curriculum and teaching methodologies can enhance learning (Haynie and Shepherd 2009). However, there is not enough em-

irical evidence about how metacognition and cognitive adaptability could be considered in the teaching process. In order to contribute to this the aim of the current paper is to assess on the basis of empirical study the role of entrepreneurship education in the development of metacognitive awareness of students. For that reason the following research questions were developed:

- 1) How different student groups are influenced by university entrepreneurship course programmes assessed through change of students' metacognitive awareness?
- 2) Which statements of metacognitive awareness are most influenced by university entrepreneurship course programmes?

The contribution of this study to scientific discussion involves presenting an assessment and analysis of the level of metacognitive awareness and its changes during the study of students with different backgrounds in the context of entrepreneurship education courses. The current study provides a possibility to extend the empirical evidence concerning students' self-assessments in terms of their metacognitive awareness, as well as to find a basis for improvement of the content of entrepreneurship courses.

Next we first define metacognition and metacognitive awareness and the importance to increase students' metacognitive awareness in entrepreneurship education. This is followed by a discussion of the chosen methodology of the study and analysis of the results. At the end both research limitations and ideas for future research are provided.

2. Theoretical Framework

Metacognition has been identified as something referring to 'the ability to reflect upon, understand and control one's learning' (Schraw and Dennison 1994: 460) or 'thinking about one's own thinking' (Georghiades 2004:365). It can be said that metacognition plays a role in how people adapt to their developing and changing circumstances that are present in any entrepreneurial processes (Haynie, Shepherd, Mosakowski and Earley 2010). It has been acknowledged that opportunities and their identification is an integral part of entrepreneurship (Sarasvathy and Venkataraman 2011) and that opportunity evaluation is always affected by risks present in an environment (Keh, Foo and Lim 2002). But the probability to recognize and interpret opportunities for success is only partially affected by environment. As addressed in past research also person's cognitive abilities play an important role in opportunity recognition processes (Baron and Ward 2004; Forbes 1999). Moreover, Hayton and Cholakova (2011) have pro-

posed that besides cognitive also closely related affective states of mind influence entrepreneurial alertness of a person. Therefore it can be assumed that increased levels of metacognitive abilities as a basis for person's cognitive ones serve for greater success in evaluating potential business opportunities.

Henry, Hill and Leitch (2005b) have in parallel argued for the greater need for people to have entrepreneurial skills in order to better adapt to a changing environment and becoming more self-reliant in facing the future. Supported by this there is a correlation between a person's metacognitive abilities and the level of their capacity to adapt to uncertainty. In addition, it is argued that the more conscious a person is about their own adopted thinking patterns, the greater the chances to overcome the individual weaknesses in the cognitive processing that affect their behaviour under different conditions. This also correlates with the findings of Schmidt and Ford (2003), suggesting that effective engagement in metacognitive abilities is critical to enhancing learning outcomes and that persons who are engaged in metacognitive activities do not necessarily work longer but spend time more effectively.

The ability to consciously utilize one's own metacognitive abilities will lead to more success when faced with novel tasks. As much as being adaptable with any task is about taking advantage of your own metacognitive abilities, it is also about raising an awareness that such abilities exist and can be developed. Backhaus and Liff (2007) found a correlation between academic performance, deep, strategic learning and metacognitive awareness of students. This presents a foundation for the reasoning in this paper. Awareness of one's own strengths and weaknesses would allow students to adjust their learning in such a manner that they will become more adaptive in the context of different tasks.

Connecting to this, Efklides (2008) has uncovered the interplay between metacognition and self-regulatory skills in learning. Schraw, Crippen and Hartley (2006) have suggested instead that self-regulation in learning involves a combination of cognitive strategy use and metacognitive control. Findings by Cassidy (2006) add that self-assessment skills involve the ability to monitor one's own learning and performance. Moreover, by using self-regulatory processes students will become more self-aware, knowledgeable and decisive in their approach to learning (Zimmerman 1990). Indeed, metacognitive abilities of students receive great importance in developing learners who are able to adapt more easily to the demands of different tasks. However, when trying to develop such skilful students one needs to also consider the impact of learning methods and study motivation. Findings of previous research have contributed to this by establishing a link between motivation of students, their performance and the level of metacognitive practices, suggesting that greater use of metacognition adds to motivation to learn and is also affecting performance (Kramarski and

Feldman 2000; Vandergrift 2005). Vos and de Graaff (2004) have additionally suggested that students learn a wider range of abilities when being exposed to active learning instead of a more traditional approach. Furthermore, Sandi-Urena et al. (2011) have reported that collaborative intervention involving metacognitive reflection helps to increase students' ability to solve problems. They also suggest that more meaningful and purposeful social interaction facilitates metacognitive development and awareness.

Considering the statements above it is possible to conclude that being aware about one's thinking patterns ultimately affects the way one pursues towards one's goals, i.e. behaves. On the other hand, the behaviour of a person is affected by the environment. Under dynamic circumstances it is important to be able to quickly switch between multiple tasks presented by rapidly changing environmental conditions. By failing to do so the person becomes inadaptably and is eventually unable to utilize its full potential. This is important not only in the university environment and related learning processes but persons are also able to take advantage of their self-analysis skills and create awareness of thinking in career building and in personal life in general. In this regard it becomes irrelevant if a person is planning to pursue an entrepreneurial (independent) career or work for someone else. In either case they will be more successful by being able to monitor themselves and adapt any steps according to the changed environment. In relation to this, the main task of entrepreneurship education is to use a teaching approach and methods which are meant to develop students' metacognitive abilities and awareness, which would motivate students to start with their own businesses or to increase their employability at the labour market. This is especially important for engineering students to support a development of their entrepreneurial mind sets and generic skills in addition to deep knowledge in their study field, and in this way to increase the employability of graduates in the labour market.

3. Study Design

3.1 Development of research model

Empirical evidence was collected using a Measure of Metacognitive Awareness (MMA) developed by the author on the basis of Metacognitive Awareness Inventory (MAI) by Shraw and Dennisson, and Haynie's original Generalised Measure of Adaptive Cognition (GMAC) (Haynie 2005). The main proposal emitting from the theoretical concept is summarised in the research model depicted in Fig. 1.

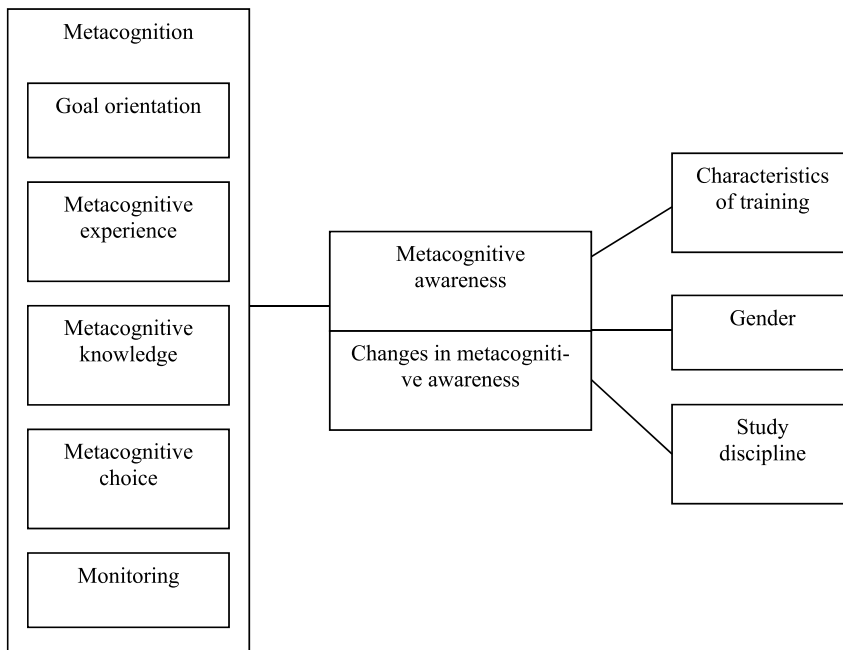


Fig. 1: Research model (author's compilation)

It is based on the argument that metacognition involves different components (such as: goal orientation, metacognitive knowledge, metacognitive experience, metacognitive choice and monitoring as proposed by Haynie) and confirmed by the results of factor analysis based on students' self-assessments of their metacognitive awareness (Ling et al. 2013). As a result of the analysis, the MMA instrument was developed by the author, which includes 29 different statements covering the above-mentioned five components of metacognitive awareness. The research model is based on measuring the changes in metacognitive awareness and its components in students that occurred as a result of the impact of the entrepreneurship education course.

In this paper the focus is on explaining the level and changes in the level of metacognitive awareness of students with different backgrounds during their study in different study programmes. Students were asked to assess the level of their metacognitive awareness in a pre- and post-course study design configuration using the MMA instrument. It is our intention to reach the results which would allow making improvements into the programmes of entrepreneurship education and to increase students' metacognitive awareness.

3.2. Sample characteristics

The author was working with two samples: The first sample included a dataset of 280 students of several disciplines taking part in a compulsory entrepreneurship training course over a three year period between 2008 and 2010. The courses lasted through the whole semester involving lectures, various practical exercises and solving teaching cases using the project based (business planning) learning approach. This means that a more traditional approach to teaching entrepreneurship was applied (Hytti and O'Gorman 2004). Here it is needful to consider that in parallel with the entrepreneurship course students had passed several other courses during the semester, which means that finally we measure the impact of all studies during the semester and the influence of entrepreneurship education is only partly influenced.

Table 1: Characteristics of the samples

	Count N	Male (%)	Female (%)	Total (%)
1	2	3	4	5
<i>First sample</i>	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
Technical sciences	140	83.6	16.4	100.0
Natural sciences	81	24.7	75.3	100.0
<i>Second sample</i>	79			
Undergraduate	74	55.4	44.6	100.0
Graduate	5	80.0	20.0	100.0

Source: author's compilation

By the variety of the disciplines, all of the students were grouped into three categories: technical sciences (information technology, mechatronics, transportation technology, product development and production engineering), natural sciences (chemistry, physics, gene technology, geology) and logistics (with business background). In addition, students from both undergraduate and graduate studies were involved.

The second sample included a dataset of 79 respondents who participated in a short and very intensive (i.e. 24 hours without a break) entrepreneurship train-

ing during 2009 and 2010. An action learning approach was used during these courses. The purpose of the course was to write a business plan 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, thus students were more motivated to learn about and for entrepreneurship (Hytti and O’Gorman 2004), and the action learning approach was used.

The first sample contained more graduate than undergraduate students in different disciplines. At the same time, the second sample included students studying mostly at the undergraduate level. Furthermore, the majority of 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 females.

3.3. Analysis

In order to answer the first research question about how different student groups are influenced by university entrepreneurship course programmes assessed through change of students’ metacognitive awareness, its level and changes were calculated on the basis of students’ self-assessments looking at the role of the study programme (e.g. two different approaches of learning, i.e. traditional project based and action learning approach), allowing to reveal the effect of students’ study motivation. Furthermore, the role of students’ gender, study level and discipline are covered as well.

The goal of analysis was to look at students more closely so that groups with different backgrounds and with different levels of metacognitive awareness would be identified. It was assumed that such groups’ present characteristics allowing making recommendations regarding the design of entrepreneurship trainings to better fit with the needs of different students.

The central idea of identifying different student groups was to distinguish the ones who, based on their MMA assessments, presented either significantly high or low levels of metacognitive awareness. As a result it was possible to compare the two groups in order to check if the respective students present similar changes in metacognitive awareness before and after the course.

For the purpose of defining the above-mentioned groups of students the clustering is carried out using the *K-means* method (MacQueen, 1967). This is a combinatorial data analysis method using a partitional clustering approach, where the objective is to maximize the intra-cluster similarity and minimize the inter-cluster similarity between data points. According to the information gained from the theoretical background and considering within the cluster sum of squared errors, the students were divided into five categories, with at least 25

students in each of them. Consequently, each respondent was assigned to a group of similar students based on the scores given to statements.

The analysis of changes in the statements of metacognition can help us also to solve the second research question of the study – which statements of metacognitive awareness are most influenced by university entrepreneurship course programmes.

4. Results

4.1 The assessment of the level of students' metacognitive awareness

The purpose of this analysis is to identify different groups of students for revealing the distinctive properties of development of their metacognitive awareness. Clustering of students from the first sample into five groups presents the necessary evidence for identifying different students based on the level of their metacognitive abilities before and after the training (Table 2). Despite the fact that there are five groups of students identified, the ones being most significant for the following analysis are the two extreme groups, i.e. metacognitively high- and low-achievers (clusters CL3 and CL5 respectively). By focusing more on these groups it is assumed that differences between them will be more prominent in every aspect of metacognitive awareness. In order to reveal the two significantly different groups of students among the ones who took part in voluntary entrepreneurship training, the second sample was clustered by adopting a similar approach. However, due to the size of the second sample (79 respondents) only two clusters were identified. This helps to avoid having several clusters with insufficient amount of data points for the following analysis.

The results of t-tests conducted on samples for establishing if the changes in metacognitive awareness scores are statistically significant indicate that among high-achievers in the first sample the changes remain insignificant in all five components (i.e. between -1.6% and $.3\%$). This means that the course of entrepreneurship education did not influence the students' metacognitive abilities. At the same time, the scores given by these students were already before the training course in the upper end of the measurement scale (i.e. 80% and more). In parallel, low-achievers in the first sample present statistically significant changes in all components of metacognition. The changes in both clusters remain above the limit of statistical significance. Thus, the results indicate that the level of metacognitive awareness has been significantly increased during the training for students in all clusters except in cluster 3 (i.e. high-achievers in the first sample).

Table 2: Metacognitive awareness of students in different clusters (% on the scale of 0...100)

	First sample					Second sample	
	CL1	CL2	CL3	CL4	CL5	CL6	CL7
N	67	81	91	10	28	49	29
1	2	3	4	5	6	7	8
Goal Orientation							
Before	76.4	72.3	85.6	76.6	55.8	79.0	58.9
After	77.2	76.9	84.2	78.6	66.1	82.8	74.3
Difference	.8	4.6 *	-1.4	2.0	10.3 *	3.8 *	15.4 *
MC knowledge							
Before	69.6	66.1	82.1	60.3	54.9	76.0	56.3
After	73.6	69.6	82.0	74.4	65.1	79.7	75.0
Difference	4.0 *	3.5 *	-.1	14.1 *	10.2 *	3.7 *	18.7 *
MC experience							
Before	63.3	74.2	80.4	65.7	57.9	76.3	59.7
After	72.9	75.3	80.7	68.3	67.4	80.3	73.2
Difference	9.6 *	1.1	.3	2.6	9.5 *	4.0 *	13.5 *
MC choice							
Before	71.2	60.9	82.9	72.3	60.7	76.3	54.7
After	71.7	67.8	81.3	76.4	67.6	79.5	69.9
Difference	.5	6.9 *	-1.6	4.1 *	6.9 *	3.2 *	15.2 *
Monitoring							
Before	72.8	71.3	84.2	74.0	65.3	78.4	63.6
After	76.4	74.3	83.8	78.9	72.0	82.0	77.8
Difference	3.6 *	3.0 *	-.4	4.9 *	6.7 *	3.6 *	14.2 *

Note: (*) denotes statistically significant difference at $p < .05$;

Source: author's compilation

The study results show that for a group of high achievers (33% of the total sample) entrepreneurship education influenced less their metacognitive awareness or the teaching method did not support the development of metacognition of those students. Such a result implies also that different methods of teaching should be used for students in these cluster, or students with higher and lower metacognitive awareness should study in different groups. Comparison of the two samples suggests that the active study method and students' motivation to study support development of these metacognitive abilities.

Table 3: Characteristics of students with high and low metacognitive awareness (% of respondents in clusters)

	First sample		Second sample	
	High-achievers	Low-achievers	High-achievers	Low-achievers
	N=91	N=28	N=49	N=29
1	2	3	4	5
Undergraduate students	35.2	35.7	89.8	100.0
Graduate students	64.8	64.3	10.2	-
Male	69.2	57.1	59.2	51.7
Female	30.8	42.9	40.8	48.3
Logistics	18.7	17.9	6.1	-
Natural Sciences	22.0	32.1	28.6	10.3
Technical Sciences	59.3	50.0	30.6	41.4
NA	-	-	34.7	48.3

Source: author's extract of first and second samples' clustering results

It is also evident that low-achieving students in both samples (clusters CL5 and CL7) present the lowest levels in all five components of metacognitive abilities before the training. After the training the same students indicate bigger than average relative increase in their assessments in all metacognitive components. For example, the scores of metacognition given to goal-orientation in the first sample increased by 10.3 per cent (from 55.8 to 66.1). In order to reveal the underlying reasons affecting the described results in relation to entrepreneurship education course, the following analysis focuses on high- and low-achieving students only (Table 3). Reasoning behind this relies on the first sample's clusters CL3 and CL5 covering altogether 40.7% of the entire sample (30.7% and 10.0% respectively). Based on this it is assumed that clusters with extreme values reflect more clearly underlying trends and provide more information about the aspects affecting the results. It is evident that in the first sample the share of graduate students is significantly higher among both high-achievers and low-achievers compared to undergraduate ones. Furthermore, the percentage of students studying natural sciences is significantly lower among metacognitively high-achievers compared to low-achievers (22.0% against 32.1%). In addition, the share of female students is smaller among the high-achievers (30.8%) compared to the ones with low awareness (42.9%). Adding to this, most of the students in the second sample are studying at the undergraduate level. But at the same time there are also more male than female students in both samples and

significantly more students have been classified into the group of high-achievers. The latter suggests that regardless of the characteristics of entrepreneurship training, students on average tend to assess their abilities at a higher level.

Table 4: Statistical significance of differences in magnitude of entrepreneurship training effect between samples (% on the scale of 0...100)

	Goal Orientation	MC knowledge	MC experience	MC choice	Monitoring
1	2	3	4	5	6
Low-achievers (1st sample/2nd sample)					
Male	11.5/13.0 *	9.0/17.3 *	8.3/15.0 *	4.5/12.7 *	8.1/13.6 *
Female	8.6/18.0 *	12.0/20.3 *	11.1/11.8 *	10.0/18.0 *	4.7/14.9 *
Undergraduate	10.0/15.4 *	13.8/18.8 *	4.7/13.5 *	7.0/15.2 *	7.0/14.2 *
Graduate	na	na	na	na	na
High-achievers (1st sample/2nd sample)					
Male	-1.5/2.5	-.4/1.9	-.3/1.3	-3.2/4.2	-1.0/4.3
Female	-1.3/5.7	.6/6.2	1.5/8.0	2.1/1.8	1.0/2.7
Undergraduate	-2.3/4.1	1.0/4.0	1.4/3.9	-.6/3.0	-.1/3.7
Graduate	-.9/1.1	-.7/1.8	-.3/5.3	-2.1/5.2	-.6/2.7

Note: The scores represent changes transferred to the initial measurement scale between 0%...100%; (*) denotes statistically significant difference at $p < .05$; "na" denotes "not available"

Source: author's extract from the test output

However, the next step is to check whether the impact of entrepreneurship trainings on metacognitive awareness of different groups of students is statistically significant. For this purpose t-tests are conducted on students' gender and study levels (Table 4). It is evident that entrepreneurship training has produced relatively bigger changes in every component of metacognition among low-achieving students compared to high-achieving ones. More specifically, the metacognitive knowledge component has presented the biggest increase among low-achieving students in terms of females and undergraduates both from the second (20.3% and 18.8%) and the first sample (12.0% and 13.8% respectively). Based on this the students in above-mentioned groups have become significantly more aware about how to make tasks cognitively more understandable and to break them down into smaller pieces regardless of the type of training (mandatory or voluntary) or learning approach (traditional or action learning) used.

It is also interesting that low-achievers present only positive changes in metacognitive awareness scores in all categories of students in both samples. This suggests that the training has affected low-achieving students to become significantly more structured and systematic in their thinking. Looking at high-achievers in the first sample, it is essential that based on magnitude these changes are statistically insignificant. However, although the magnitude of changes remains below the limit of statistical significance and in some metacognitive components it gets even lower it is probably not indicating negative impact on high-achieving students' metacognitive awareness and their potential success. Instead it is possible that students have become more aware about the level of their metacognitive abilities after the training. It is reasonable to expect there exists additional variable(s) which has(ve) not been covered in the frame of the current study. It might be the case that high-achieving students start assessing their cognitive processes more realistically after the course. Such an explanation is supported by findings of Ehrlinger et al. (2008) and Langendyk (2006) suggesting that there is a tendency of under-estimation among high-achieving persons. In this case it is justified that the scores got lower.

However, it should not be forgotten that students in the first sample took the mandatory entrepreneurship training course (incl. traditional learning method) when the second group was involved with a voluntary one (incl. action learning method). In this context the study motivation of students could be of significant importance in an attempt to explain the changes in metacognitive awareness. This is supported by the findings of Kramarski and Feldman (2000) and Vandergrift (2005) who established that study motivation is likely to have an impact both on the degree students' metacognitive practices and also their performance. At the same time Kleitman and Stankov (2007) have proposed that metacognitive awareness correlates with the level of self-confidence. If this is correct, then based on the results of entrepreneurs' psychological portrait the level of students' metacognitive awareness in different clusters differs substantially. In the first sample the rate of students classified as self-confident is much larger among high-achievers than among low-achievers (71% and 57% respectively). Similarly, in the second sample there is 82 per cent of self-confident students among high-achievers, compared to 72 per cent among low-achievers. This indicates that students in the second sample have become more confident about their metacognitive processing than the ones in the first sample. Such a difference can be explained by higher motivation among students in the second sample as well as by using the active method of study compared to the first sample where the students' motivation was lower and traditional methods of study were used.

Concerning the magnitude of change among males and females the analysis suggests that females, especially in the second sample, rate their metacognitive

abilities significantly higher than males. A similar trend is also available in the first sample, although the differences are not as big and they are not statistically significant in terms of goal-orientation and metacognitive choice. Therefore the effect of entrepreneurship training is bigger on females than males suggesting that the gender of students is an important factor. Still, these results are unexpected as they contradict with theoretical evidence of both Memnun and Akkaya (2009) and Stewart, Cooper and Moulding (2007) who proposed that gender of students does not have a significant influence.

In this context it is interesting to look at the differences between study-disciplines of students. Interestingly, the effect on students studying logistics and natural sciences remains largely below the criteria of statistical significance between both samples.

Additionally, it is important that on the basis of students' self-assessment, the influence of courses is different by different components of metacognitive abilities. For example, goal-setting skills have been significantly changed by the training among low-achievers in all different groups of students. Indeed, related skills have been a focus of educators, in terms of teaching, for many years and scholars have identified goal setting as one of the critical abilities for everyone. Therefore it has been assumed that effects of entrepreneurship training are also prominent in the goal orientation component. Comparing low- and high-achieving students in both samples based on the magnitude of change in all metacognitive components after the training, a similar trend is apparent, as seen from Table 5.

Table 5: *Difference between high- and low-achieving students' metacognitive awareness by components (% on the measurement scale of 0...100)*

Metacognitive component	Second sample			
	before	after	before	after
1	2	3	5	6
Goal Orientation	34.8	21.5	25.4	10.2
MC knowledge	33.2	20.6	26.0	5.8
MC experience	28.0	16.4	21.7	8.9
MC choice	26.8	17.0	28.3	12.0
Monitoring	22.4	14.1	18.9	5.1

Source: author's compilation

Students' metacognitive abilities in two different groups (i.e. high- and low-achievers) have become closer to each other after entrepreneurship training, suggesting that low-achieving students' reasoning has become more comparable to high-achieving ones. In addition to goal orientation, abilities related to making new information more understandable (i.e. metacognitive knowledge) has also received a substantial change (difference decreasing by 12.6 and 20.2 per cent among samples respectively). In parallel, students' metacognitive choice and monitoring abilities in the first sample have changed less (9.8% and 8.3%) with the training compared to other components. The fact that self-monitoring abilities have been affected less by the training suggests that students might not consider such abilities equally important compared to others or these aspects have not been considered sufficiently in the study programmes.

Until now the focus of this analysis has been on attempting to explain the changes in high- and low-achieving students' metacognitive abilities by exploring the respective components on a more general level. But the actual reasons of the changes and their impact on entrepreneurship training have still not been sufficiently uncovered. Consequently, for the purpose of explaining in more details what might be causing the presented changes it is necessary to look into the dynamics of individual statements (Table 6). Based on the average values calculated for each of the five metacognitive components, the magnitude of changes among low-achievers is relatively higher than those of high-achievers also in all individual statements in both samples. Besides this, the changes among high-achievers in the first sample remain below the limit of statistical significance. The impact of training among low-achievers extends from 2% up to 21% depending on the component of metacognitive awareness. The fact that the rate of change poses such a positive consistency over all the five components allows suggesting that the training had higher impact on low-achieving participants in all aspects of metacognitive awareness. Positive correlation between training outcome and increased metacognitive awareness also supports the theoretical assumptions by which the metacognitive training has positive impact both on decision-making capabilities (Batha and Carroll 2007) and critical thinking (Magno 2010).

Based on the evidence that the magnitude of changes in students with low metacognitive awareness in both samples is (as expected) significantly higher in all five components of metacognition it is needful to analyse the statements which were most influenced. On the basis of the results of analysis it will be possible to identify the need for the improvement of the entrepreneurship course programme. Looking at the table in Appendix it becomes evident that there are 2–3 statements in every component where comparably significant changes have occurred.

The goal-orientation statement “I ask myself how well I have accomplished my goals once I have finished” present significant increases, especially among low-achievers in both samples (20% and 15% respectively). Also the statement „When performing a task, I frequently assess my progress against my objectives” has changed among students in both samples (17% and 21% respectively). The statements “I set specific goals before I begin a task” and “I organise my time to best accomplish my goals” has changed most among students of the second sample (19 and 21% respectively). These results show that study programmes support the goal orientation development among students, and this is supported more strongly through the type of teaching method (i.e. action learning) and motivation of students (i.e. voluntary study programme). The same conclusions can be made also when analysing the impact of study programmes on other components of metacognition.

Looking into the aspects related to metacognitive knowledge, this involves both students’ skills to focus on the most important aspects of new information, questioning their own assumptions when confronted with novel tasks and having more knowledge on how to disassemble bigger problems into more manageable smaller tasks. Related to this, the scores of the first sample’s low-achieving students given to the statements “*I challenge my own assumptions about a task before I begin*” and “*I ask myself questions about the task before I begin*” show significantly increased values (by 13% and 11% respectively). Among the second sample’s students the trend is almost the same with the exception of the statement “*I try to break problems down into smaller components,*” which presents the highest level with a 26% increase. Low-achieving students seem to perform better in already familiar conditions or put high value into the information reviewing practices, allowing to suggest that students possess a certain level of metacognitive awareness already prior to the training. In terms of skills involving awareness about finding different ways to solve a problem and analysing itself about the rate of learning after the task has been finished the statement “*I ask myself if I have learned as much as I could have after I finish the task*” provides the magnitude of change as large as 14% (first sample) and 21% (second sample) among low-achievers. Supported by that it seems to be the case that metacognitively low-achieving students initially possess only limited cognitive skills in analysing the results and taking the best of them for improving the performance in the future tasks. Considering the rate of change, they are nevertheless improving themselves significantly within a limited timeframe.

Among metacognitive experience the statement “*I consciously focus my attention on important information*” presents significant increases, especially among low-achievers in the first and second sample (14% and 12 respectively). This supports the suggestion that students with a lower level of metacognitive

awareness are more likely to have bigger impact and take greater advantage of the courses. On the other hand, a large magnitude of change coupled by a low level of initial scores suggests the students become more cognitively aware through learning, although lower levels of awareness before the course indicate that they know only moderately the best cognitive strategies for any given task. Only the changes in the metacognitive experience component in the second sample are bigger than in the first sample. Increase is available in the task-specific awareness of strategy-use, i.e. statement "*I am aware of what strategies I use when engaged in a given task*" (16%). On the other hand, skills related to prioritizing information "*I know what kind of information is most important to consider when faced with a problem*" have increased also most among students of the second sample (21% compared with 12% in the first sample). Consequently there is evidence available suggesting that entrepreneurship trainings in general affect students from multiple disciplines in a different manner.

Among the component of metacognitive choice bigger changes have occurred among students in the second sample, e.g. in the statements: "I ask myself if I have considered all the options when solving a problem" (20%), "I ask myself if there was an easier way to do things after I finish a task" (13%) and "I ask myself if I have considered all the options when solving the problem" (13%). Therefore the motivation of students and action learning method are supporting most the metacognitive choice of students.

The impact of study programmes on the monitoring statement "*I find myself analysing the usefulness of a given strategy while engaged in a given task*" experienced the biggest increase among the students of the second sample (20% compared with 10% of the first sample). The impact is considerable also on the statement "*I find myself pausing regularly to check my comprehension of the problem situated at hand*" (10% in the case of first and 16% of second sample). But the statement "*I stop and go back over information that is not clear*" has been highly assessed by students of the second sample (18%), but around six times less by the students of the first sample (3%). From here a conclusion is that traditional teaching methods do not support development of students' monitoring abilities.

Based on the results of analysis above, it has been successfully shown that high- and low-achievers have properties that make them different from each other. Therefore it comes out that various groups of students should be approached differently during entrepreneurship training in order to benefit from the courses to the fullest extent. Hence the results should be taken into account for the improvement of students' performance.

5. Conclusions and Discussion

The purpose of this research was to contribute to the assessment practices of students' metacognitive awareness by presenting and testing empirically a model that contributes to existing theory by exploring the link between five inherent components of metacognition and different types of entrepreneurship training. On the basis of empirical research including two individual samples consisting of students participating in entrepreneurship training courses with different configurations and students with varying backgrounds, the research contributes to the impact of entrepreneurship education in the development of students' metacognitive awareness. Among student groups gender, the effect of study discipline and study motivation were explored. Also, the impact of study programmes on different statements of students' metacognitive awareness were deeply analysed with the aim of finding a basis for improvement of the content of entrepreneurship courses.

The current research shows that the research model based on measuring of the changes in the metacognitive awareness of students with different backgrounds makes it possible to verify the impact of entrepreneurship education courses on students' metacognitive awareness. The use of MMA (Measure of Metacognitive Awareness) instrument brings out the most critical aspects in metacognition, which are needful to consider in planning the study programmes. This suggests that the current study contributes by filling a gap in existing entrepreneurship research by extending the empirical evidence concerning students' self-assessments in terms of their metacognitive awareness.

Considering that the metacognitive awareness of students was calculated before and after the course and students in both samples were classified as metacognitively high- and low-achieving ones, the analysis of the results indicated certain differences between students in the degree of change in metacognitive abilities as a result of entrepreneurship training. Although the reasons affecting such an outcome are not revealed to its full extent in the frame of this study, the fact that the training courses had positive impact on students' self-analysis and assessment skills supports the findings of Henry et al. (2005b).

The results clearly indicate that the impact of entrepreneurship training courses on different student groups is bigger for metacognitively low-achieving ones. However, it is necessary to remember that the changes to high-achieving students' metacognitive processing were statistically insignificant. It might be that high-achieving students already employed metacognitive processing skills to a greater extent before the training even began, making it difficult to make a substantial impact on their skills. In parallel, low-achieving students present evidence suggesting that they are more successful in adapting their cognitive pat-

terns according to the environment. This is supported by additional findings showing that the differences between high- and low-achieving students' metacognitive awareness scores decreased substantially after the training. Therefore it is evident that the skills of metacognitive information processing have grown similar between two clusters of students after the trainings on the account of increasing level of metacognition among low-achievers. The fact that there were minimal changes in metacognition among high-achievers directs to the idea that these two clusters of students require separate study programmes according to the specific needs of both groups of students.

Following this it is possible to influence and develop students' awareness about their own cognitive patterns through university courses. Nevertheless, there were also differences in training programs. For the students in the first sample the training program was mandatory (with traditional learning approach) as opposed to the second sample taking a voluntary (with action learning approach) one. This is likely to have an effect on the results in terms of students' study motivation supplemented with the use of different learning approaches. The findings of this study correlate with the theoretical assumption by which the study motivation affects the students' metacognitive abilities and performance.

In addition, the results indicate there is a significant difference between male and female students' self-reported levels of metacognitive abilities. The changes are present among all the components, although on average they are greatest among high-achieving students in goal orientation. For low-achieving students, on average, the biggest differences are instead in metacognitive knowledge. More importantly, regardless of the exact components the results contradict with the theoretical underpinnings of Memnun and Akkaya (2009) and Stewart, Cooper and Moulding (2007) who proposed that the gender of students does not have significant influence.

The findings of the current study suggest that entrepreneurship training courses should be designed by keeping greater focus on specific needs of different students. Supported by Anderson (2011), there is a stronger need to focus more on the contents of the courses for different groups of students in order to utilize the strengths of universities. By designing the training course so that students' attributes are considered the overall usefulness of the training is likely to be increased. The detailed analysis of the different statements of the measurement tool revealed certain aspects of metacognitive awareness that necessitate consideration for improving the content of training courses, e.g. in supporting development of students' metacognitive awareness, especially in metacognitive choice and monitoring, but also considering specific statements across all different components of metacognitive awareness.

Based on the results of the research, the contribution of this study to scientific discussion involves presenting an assessment and analysis of the level of metacognitive awareness and its changes during the study of students with different backgrounds in the context of entrepreneurship education courses. The current study provides a possibility to extend the empirical evidence concerning students' self-assessments in terms of their metacognitive awareness, as well as to find a basis for improvement of the content of entrepreneurship courses.

6. Research Limitations and Ideas for Future Research

There are several aspects that should be taken into account when interpreting the findings of this research. It is important to utilize the instrument empirically also in other environmental contexts. This makes it possible to compare and better generalise the results of the surveys. Moreover, the contribution can be made by extending the diversity of study disciplines, i.e. by involving students studying business administration and economics, arts and design and others. The findings of the current research also suggest that the gender of students is an important factor influencing metacognitive awareness. As this contradicts with earlier research evidence, it is expected that the effect of students' gender will be studied more in future research.

In addition, the use of only a quantitative measurement tool does not allow explaining the evidence in full detail, a qualitative survey is needed as an additional tool. It is likely that there exist more latent variables affecting the results than covered in this study.

It is the author's hope that the contribution into the theory of metacognition assessment by presenting a model will generate more research in the future aiming to elaborate the relationship between the success of different students and the level of their metacognitive abilities.

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Appendix 1. Changes in metacognitive awareness among high- and low-achieving students (% on the measurement scale of 0...100 %)

	First sample		Total	Second sample		Total
	HA	LA		HA	LA	
I	2	3		4	5	
Goal Orientation						
I often define goals for myself		6.8	3.8	3.9	11.0	7.5
I understand how accomplishment of a task relates to my goals	-3.2	8.2	2.5	3.9	11.0	7.5
I set specific goals before I begin a task		9.3	4.9	3.9	18.6	11.2
I ask myself how well I have accomplished my goals once I have finished		19.6	9.6	4.3	14.8	9.6
When performing a task, I frequently assess my progress against my objectives		16.8	7.8	4.9	21.2	13.0
I think about what I really need to accomplish before I begin a task			0.7		10.7	5.8
I organise my time to best accomplish my goals	-4.9	8.2	1.6	5.1	21.0	13.1
Average	-1.4	10.3	4.5	3.8	15.4	9.6
Metacognitive knowledge						
I challenge my own assumptions about a task before I begin	2.6	12.9	7.7	3.5	15.9	9.7
I ask myself questions about the task before I begin	3.0	11.1	7.0	7.6	21.0	14.3
I try to translate new information into my own words		7.1	4.1	3.1	13.1	8.1
I try to break problems down into smaller components		10.4	4.5	3.1	25.9	14.5
I focus on the meaning and significance of new information	-5.6	10.0	2.2		17.9	9.5
I ask myself if I have learned as much as I could have after I finish the task		14.3	6.7	4.3	21.4	12.8
I periodically review to help me understand important relationships		5.7	3.2	3.3	18.3	10.8
Average	-0.1	10.2	5.1	3.7	18.7	11.2
Metacognitive experience						

I use different strategies depending on the situation		6.8	2.6		10.7	5.8
I am good at organising information		10.0	5.6	5.3	14.8	10.1
I know what kind of information is most important to consider when faced with a problem		11.4	6.6	5.7	20.7	13.2
I consciously focus my attention on important information		13.9	6.5	3.3	12.1	7.7
I am aware of what strategies I use when engaged in a given task		8.9	5.4	8.4	15.5	11.9
Average	0.3	9.5	4.9	4.0	13.5	8.8
Metacognitive choice						
I think of several ways to solve a problem and choose the best one			-0.6		8.6	5.1
I ask myself if I have considered all the options when solving a problem	-1.6	5.7	2.0	5.3	13.1	9.2
I ask myself if there was an easier way to do things after I finish a task	-3.3		-0.4	2.4	13.1	7.8
I ask myself if I have considered all the options after I solve a problem		12.1	5.3	2.4	20.0	11.2
Average	-1.6	6.9	2.7	3.2	15.2	9.2
Monitoring						
I perform best when I already have knowledge of the task		3.9	1.4		4.8	2.9
I try to use strategies that have worked in the past		6.1	2.7		6.9	3.7
I stop and go back over information that is not clear		8.2	3.2		17.6	9.7
I find myself analysing the usefulness of a given strategy while engaged in a given task		10.4	5.7	2.2	20.0	11.1
I find myself pausing regularly to check my comprehension of the problem situated at hand		10.0	4.9	10.8	15.5	13.2
I ask myself questions about how well I am doing while I am performing a novel task. I stop and re-read when I get confused			0.3	2.4	9.0	5.7
Average	-0.4	6.7	3.2	3.6	14.2	8.9

Source: author's compilation;

Note: HA denotes high-achievers and LA low-achievers

APPENDIX 4

Ling, H., Venesaar, U. (2014). Enhancing entrepreneurship education of engineering students for increasing their metacognitive abilities: analysis of students' self-assessments. *Engineering Economics*. (Forthcoming)

Enhancing entrepreneurship education of engineering students for increasing their metacognitive abilities: analysis of students' self-assessments

Hannes Ling, Urve Venesaar

Tallinn School of Economics and Business Administration
of Tallinn University of Technology
Akadeemia tee 3, 12618 Tallinn, Estonia
e-mail: hannesling@smail.ee, urve.venesaar@tu.ee

It has been widely accepted that the discipline-specific professional knowledge of engineering graduates alone is not sufficient for a successful career. Thus, it is becoming increasingly important to enhance also the abilities of a person to apply the knowledge into the real-world environments, characterized by change, complexity and uncertainty. The on-going scientific discussion has addressed this by sharing the importance of development of meta-cognitive abilities in education, enabling to foster entrepreneurship and employability of engineering students. This can be achieved through appropriately focused and systematic entrepreneurship education programs in universities, while the goal of such programs is to facilitate students' preparedness for an enterprising life in the future. Moreover, it is acknowledged that any person should be able to benefit from entrepreneurship education programs even if not starting their own company, as the focus is on increasing the creativity, self-efficacy, systematic thinking, awareness about opportunities and learning to learn. Hence, persons who understand what they know and understand how to control their own learning are also more likely to understand how to apply what they have learned.

The aim of the current paper is to further develop the scientific discussion on the development of metacompetencies of engineering-students through entrepreneurship education, with an emphasis towards metacognition and providing suggestions for the

1. Introduction

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

Hence, the focus of education has to be on students in universities; as they will likely have the greatest impact towards 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, as for their successful careers it is essential to

development of entrepreneurship courses with the aim of increasing the level of metacognitive abilities and awareness of students. Previous research on metacognition has largely concentrated on theoretically defining components of metacognition, explaining the relationship between the metacognitive awareness and propensity to start entrepreneurial careers, as well as on the importance of metacognition in learning. At the same time the amount of necessary empirical evidence is still limited. Current research is an attempt to contribute into the empirical analysis of self-assessment of metacognitive abilities of students with different personal characteristics, study level and disciplines. The study includes a quantitative survey using Likert scale. The results have been analysed with the means of linear statistical analysis for evaluating the level of students' metacognitive abilities and K-means clustering method for identifying groups of high- and low-achieving students.

The results of study have confirmed that the differences and weaknesses in metacognitive awareness of students from different study levels and disciplines need to be considered when planning entrepreneurship courses. The article is contributing to the development of the courses of entrepreneurship education based on improving the weakest components of students' metacognitive abilities. In addition, the study contends that the issues of study environment and motivation of students are important factors to consider when designing entrepreneurship courses.

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

have both excellent professional and entrepreneurship competencies.

In addition, previous research has contended that development of competencies takes place in the interaction of metacompetencies (Cheetham & Chivers, 1998). Thus, it is needed to develop metacompetencies of students, which can be achieved by fostering the learning of metacognition, meta-conation and meta-affection as outcomes of teaching (Kyrö, 2006). Still, it can be argued that the current state of research does not allow to clearly identify all three components of meta-abilities of a person in the frame of entrepreneurship competencies. Scholars have also turned their attention to an extent to which these components are perceived, or their 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 all individual components of metacompetences, in the context of entrepreneurship education, except the instrument to measure metacognition. Therefore, the empirical research

in this article focuses on metacognition, in order to enhance the success and employability of students studying engineering-related disciplines.

The aim of this research is to search for ways to develop the metacompetencies of engineering-students through an entrepreneurship education program. In line with that, the research model of entrepreneurial and enterprising competencies, with the inclusion of metacompetencies, is developed to understand the frame of metacompetences for further research. The current research is measuring the level of students' metacognition and the research question is formed as the following: How to enhance entrepreneurship education of engineering students for increasing their metacognitive abilities?

A theoretical framework provides an overview of different approaches to metacompetencies in terms of success in learning and employability of an individual in the labour market. More specifically, the concept of metacognition as an ability facilitating the adaptability of a person is discussed.

In order to collect necessary empirical data, both the undergraduate and graduate engineering students have been asked to fill the questionnaire, *Measure of Metacognitive Awareness* (MMA), allowing to reveal the structure and level of metacognitive abilities of 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 both before and after the entrepreneurship education program.

The contribution this research brings is to present the research model, where metacompetences are part of entrepreneurial and enterprising competences, and to find a way to enhance the entrepreneurship education of engineering students in order to increase their metacognitive abilities, so that their entrepreneurship competencies will be increased and they can become more adaptable and successful.

2. Theoretical framework

2.1. 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 the success both in entrepreneurship and when facing uncertainty in other contexts.

Scholars have shared that competencies are abilities of a person to use knowledge and to make things happen (Boyatzis, Stubbs, & Taylor, 2002). Still, enterprising persons 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 into individuals success 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, sense of entrepreneurship and cultural awareness (Deakin Crick, 2008). With that, it has been acknowledged that metacompetencies are certain key competencies overarching the others (Cheetham & Chivers, 1996).

Competencies of a person can be enhanced with 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 contrasting with an enterprising reality where only limited information is available at any moment (Henderson & Robertson, 1999). In line with this, research findings suggest that learning is becoming extensively dependent on the initiative of an individual (Weinert et al., 2011), and that the nature of learning is changing to include more personalised, enterprising elements (Rae, 2010). Carey and Matlay (2010) have witnessed that there is a consensus among scholars about a growing pressure on higher education to become both more enterprising and entrepreneurial.

Thus, it is necessary to make a distinction between enterprising and entrepreneurial learning concepts. Rae (2005) has argued that while entrepreneurial learning focuses on managing ventures thru recognizing and acting upon opportunities, enterprising learning is instead led by creativity, informality, curiosity and emotion. Therefore, developing enterprising learning competency requires the person itself 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 intentions to understand and construct meaning of the content to be learned (Gijbels et al., 2005). Surface learning in parallel places more emphasis on memorizing what has been learned, and focuses on memorizing and reproducing the factual contents. Deep learning is therefore engaging more metacognition of a person, enhancing 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, not just to assume that one strategy is *a priori* better in any circumstances. Persons who understand how to control their own learning are also more likely to understand how to apply what they have learned.

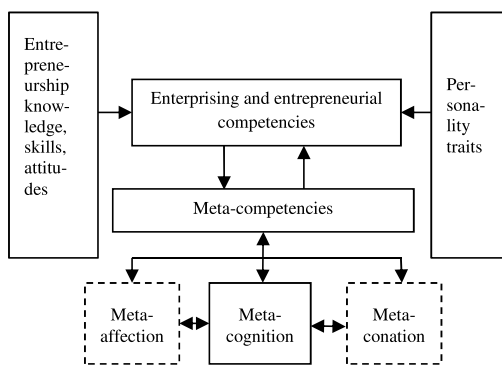
As a response to this, findings have asserted that being able to recognize and evaluate the learning of a person is important for reflecting on the thinking processes, and that making students aware of their learning can be promoted by metacognition (Boström & Lassen, 2006). It has been additionally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

2.2. Model of metacompetencies with the emphasis to metacognition

It has been observed that self-development, coupled with communication, creativity, analysis and problem solving, is one of the core metacompetencies of a person, aiming to assist in developing other competencies (e.g. self-development) or enhancing competence 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 of an individual (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 the knowledge or awareness about their strengths and weaknesses in learning, leading to greater adaptability. Besides, development of entrepreneurship competencies, together with professional knowledge and skills increases the competitiveness of students and graduates on the labour-market.

On the other hand, it is crucial to be able to control and assess the progress of learning to fit with the demands of the task at hand, so that available resources are used effectively. In line with that, Kyrö *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 enterprising and enterprising competences with the inclusion of metacompetencies in learning (Fig. 1) builds upon the argument that it can be developed with appropriately focused entrepreneurship education, and that metacompetencies, involving self-development and adaptability, facilitate meta-abilities of a person influencing his/her behaviour in entrepreneurship.



Note: This research is focused on metacognitive component of meta-abilities. Therefore the meta-affective and metaconative abilities are depicted with a dashed line

Fig 1. Model of enterprising and entrepreneurial competencies with inclusion of meta-competencies of a person in learning.

Following the findings of Cheetham and Chivers (1998), the model also incorporates the feedback-loop connecting the competencies with both the self-

development and adaptability (ie. metacompetencies) and metacognitive abilities of a person. Findings of past research has underlined that based on the tripartite model of personality and intelligence of a person in education (Kyrö, Mylläri, & Seikkula-Leino, 2008), besides metacognition also meta-affect and meta-conation have to be fostered. Nevertheless, scholars have stressed the central role of metacognition (Ramocki, 2007), and that it can serve as an indicator of metacompetency of a person (Weinert *et al.*, 2011). Therefore, the current research focuses into metacognitive abilities in entrepreneurship education, in order to study how entrepreneurship education can contribute into the development of metacognitive abilities (including: metacognitive knowledge, metacognitive experience, metacognitive choice and monitoring) of students in universities.

The question is whether the content of entrepreneurship courses and teaching methods are encouraging the development of metacognitive abilities of engineering students? The results of students' self-assessment can help to find the weakest aspects in their learning, and consequently to improve the programme and teaching methods in future courses of entrepreneurship education.

2.3. Metacognition and metacognitive awareness in entrepreneurship education

Metacognition has been referred to as 'thinking about one's own thinking' (Georghiades, 2004:365). 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 apply when specific situations or problems arise (Efklides, 2009), or an extent to which a person is interpreting 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 on its behalf is an important resource that activates skills, controls action and behaviour (Efklides, 2009). It serves as a conduit through which previous memories, intuitions, 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 a set of available ones for managing the changing environment. Albeit, they suggest also 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 and Dennison (1994) suggest that metacognitive awareness is something allowing 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 persons who choose to become cognitively engaged are those who are interested in tasks they work on and in parallel see value in it. In line with that, past research has asserted that metacognition facilitates employability of a person (Fynn, 2007; Yorke & Knight, 2004), and that individuals who reflect more actively about their goals and know what they want to attain, report a higher level of success (De Vos & Soens, 2008). Hence, teaching and learning methods facilitating success of students need to be personally engaging, and be based on active involvement of students (Watts, 2006). Therefore, increasing groupwork in school, and integrating this with real-world experiences, is motivating 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 efforts based on their awareness and understanding of the level of difficulty of tasks (Isaacson & Fujita, 2006).

3. Methodology

3.1. Study Design

For the purposes of finding how to enhance the adaptability of engineering students through increasing their metacognitive abilities with study programmes, the students at Tallinn University of Technology, participating at the courses of entrepreneurship education have been asked to fill the questionnaire *Measure of Metacognitive Awareness* (MMA) (Ling, Kyrö & Venesaar, 2013). Although the research has involved a group of students participating at the entrepreneurship courses it is not correct to argue that only the course of entrepreneurship education has an impact to students' metacognitive abilities and awareness. Instead, students have also taken part in several other courses during a semester, which are likely to have an impact. Nevertheless, in general the predominantly traditional teaching methods have been used across the courses during the semester. As such, the course of entrepreneurship education is considered to be the most appropriate to adopt the approach, which is encouraging the development of students' entrepreneurial

and enterprising competencies. With that the article is focused on enhancing students' metacognitive awareness through participation in entrepreneurship education courses.

This allows to identify if the university study programmes and particularly entrepreneurship course programme has an effect on the level of metacognition of respondents and which statements (and respective components of metacognition) would require more attention for enhancing students' 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 right after the course.

The MMA questionnaire included 29 different statements on the 10-step Likert scale, divided between five components as *goal orientation*, *metacognitive knowledge*, *metacognitive experience*, *metacognitive choice* and *metacognitive control (monitoring)*. Respondents were asked to score each individual statement on the scale of 1 to 10, based on their own judgment where "1" being equal to *Not very much like me* and "10" being equal to *Very much like me*.

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

3.2. Sample characteristics

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

By the variety of the disciplines, all of the students were grouped into three categories: technical sciences (infotechnology, mechatronics, transportation technology, product development and production engineering), natural sciences (chemistry, physics, genetechonology, 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 a short and very intensive (i.e. 24 hours without a break) entrepreneurship training during 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, thus students were more motivated to learn *about* and *for* entrepreneurship (Hytti & O’Gorman, 2004).

Table 1. Characteristics of the samples

	Count N	Male (%)	Female (%)	Total (%)
<i>First sample</i>	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
<i>Second sample</i>	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. At the same time, the second sample includes students studying mostly at the undergraduate level. Furthermore, the majority of 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 females.

3.3. Data analysis

In order to answer the research question about how to enhance entrepreneurship education of engineering students for increasing their metacognitive abilities and awareness, the changes in levels of different statements of metacognition were calculated on the basis of students’ self-assessments. Moreover, in order to pick up the weakest components and statements of metacognition, requiring more attention in engineering education, the groups of respondents who have scored at least one statement with 1, 2 or 3 points on the 10 point scale, have been identified. 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, allowing to analyse the results of their self-assessment. In a similar manner from the second sample, looking at the role of the study programme (i.e. compulsory, traditional project based, and voluntary training, involving more of the action learning approach), the weak components have been identified among the students in the second sample. Thus, the 35 respondents (44% of the sample) before the course, and 21 respondents (i.e. 27% of the sample) after the course have been identified. With that it is possible to reveal the effect of students’ study-motivation and its influence to the results of learning.

The goal of analysis was to look at students more closely so that groups with different backgrounds and with different levels of metacognitive awareness would be identified. It was assumed that such groups’ present characteristics allowing the making of recommendations

regarding the design of entrepreneurship courses to better fit with the needs of different students.

For the purpose of defining the above mentioned groups of students, the clustering is carried out using the *K-means* method, which is a combinatorial data analysis method utilizing a partitional clustering approach. In that, the objective is to maximize the intra-cluster similarity and minimize the 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.

4. Results

4.1. Metacognitive abilities of students with different characteristics

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

Table 2. Difference between high- and low-achieving students’ metacognitive awareness by components (% on the measurement scale of 0...100)

	Goal Orien- tation	MC know- ledge	MC expe- rience	MC choice	Moni- toring
<i>First sample</i>					
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
<i>Second sample</i>					
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 the goal-setting skills (i.e. goal orientation component) has been decreased up to 11.7% after the training course in the first sample. Among the students from the second sample, the difference has decreased similarly by 11.5%. Aside from the fact that the magnitude of these changes are among the biggest ones, it maintains that related skills have, indeed, been a 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 take systematically the steps to achieve them,

have developed relatively more than some other components of metacognition.

In addition to goal orientation, also abilities related to making new information more understandable to itself (i.e. metacognitive knowledge) has changed much (difference decreasing by 10.4 and 15.2 per cent among samples respectively). Nevertheless, it is evident that students' abilities to see different routes in moving towards goals (i.e. metacognitive choice) and to control when the goal has been achieved (i.e. monitoring) in the first sample have changed less (8.4% and 7.1%) with the learning during the course compared to other components. The differences among the high- and low-achievers in the second sample have, however, 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 students might not consider such abilities equally important compared to the others.

Until now the focus of this analysis has been on uncovering the differences in high- and low-achieving students' metacognitive abilities. 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).

Table 3. Average scores of students' metacognitive awareness, before the course (% on the scale of 0...100)

	Goal Orientation	MC knowledge	MC experience	MC choice	Monitoring
<i>First sample</i>					
low-achievers	55.8	54.9	57.9	60.7	65.3
high-achievers	85.6	82.1	80.4	82.9	84.2
<i>Second sample</i>					
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

It is evident that the low-achieving students already assess before the course the level of their metacognitive abilities significantly lower compared to high-achieving ones. For example among the students taking part of the mandatory course (first sample) the goal orientation component among the low-achievers has been assessed only at the level of 55.8% on the measurement scale. At the same time, metacognitive knowledge has been scored the lowest, at only 54.9% at the beginning of the course. While the monitoring and metacognitive choice component has been assessed higher (65.3% and 60.7%), it is still only at a moderate level before the course. The similar trend is available also among the students in the second sample. Thus, the training has the possibility to contribute significantly into the development of low-achieving students' metacognition.

However, when looking into the assessments of metacognitively high-achieving students, the levels of assessments are, as expected, significantly higher before the entrepreneurship courses. Aside from that the high-achievers in the first sample have assessed their

metacognitive abilities higher than those in the second sample.

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

4.2. Enhancing entrepreneurship education with identifying the weakest aspects of students' metacognition

After identifying different groups of students the focus should be turned towards presenting the individual statements which have been scored the lowest before the training. This allows to point out the aspects needing on average more attention in the entrepreneurship courses (Table 4).

Table 4. Percentage of students with weakest aspects of metacognitive abilities from both samples before and after the course (% of the entire samples).

	First sample		Second sample	
	Before N=126	After N=82	Before N=35	After N=21
<i>Goal Orientation</i>				
A	4.3	1.8	11.4	2.5
B	7.9	6.1	6.3	
<i>Metacognitive knowledge</i>				
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
<i>Metacognitive choice</i>				
G	6.4	4.3	6.3	6.3
H	6.4	5.0	12.7	2.5
<i>Monitoring</i>				
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 situated at hand

Note: only the biggest shares have been shown

Source: author's compilation based on survey results

Based on the shares of students in this subset the levels of metacognitive abilities have been mostly improved in all the components. Although the metacognitive experiences are not listed, it does not mean that there is nothing needing improvement regarding students' abilities to

utilize their past experiences in organising the information or in recognizing the most important one. The deficiencies regarding this component were just reported by a relatively smaller group of students compared to the others.

Looking at the data it can be seen that some of the statements represent the abilities which are problematic for all the students. For example an aspect F (*I ask myself if I have learned as much as I could have after I finish the task*) relating with the ability to learn from the already completed tasks appears to also remain problematic after the courses in both students' samples. Still, the fact that the amount of students, assessing this statement lower, has been 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 the retrospective monitoring of self, helps in learning. Thus, the students' study-motivation might also be improved. However, it also can be that students have the habit or are more accustomed just to go thru the studies and graduate instead of actually learning how to enhance their knowledge and skills.

Still, weaknesses in retrospective self-assessment skills in both students' samples become evident with 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 situated 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 the crucial problem-solving skills. In line with that, the weaknesses in students 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) for achieving a better performance. The deficiencies in the latter also imply that students might not have sufficient need to achieve completely solving the tasks.

Looking in parallel at aspect C (*I challenge my own assumptions about a task before I begin*) involving the ability to question their own assumptions before beginning with a task, it seems that students do not value enough 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 have rated this low). This, on its behalf, might indicate that students have adopted during their studies the more superficial approach towards solving tasks, aiming just to completing what has been asked to do.

Nevertheless, the weaknesses in questioning itself about understanding a task (*I ask myself questions about the task before I begin*, aspect D) can also be explained by the lack of providing to students the necessary experience during earlier studies. In this case a person has not developed essential analysis-skills to understand the context and requirements of tasks. It is supported with looking at aspect E (*I try to break problems down into smaller components*) involving metacognitive knowledge in terms of ability to disassemble problems into smaller tasks and get a deep understanding of the problem.

However, 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. Thus, the students might need additional training on planning the steps to achieve their goals and to purposefully solve them. Hence, while this aspect is weaker among the students in the first sample, it can be the result of using traditional teaching methods that involve lectures and both theoretical and impractical tasks. The analysis of the weakest statement among the metacognitive components reveal to a missing strategy and environment for teaching entrepreneurship for increasing students metacognitive abilities and their success in learning.

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

Table 5. Differences between weakest aspects in terms of study-level and gender (% of samples before/after the course)

	Under-graduate	Graduate	Male	Female
<i>First sample</i>				
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
<i>Second sample</i>				
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

Based on this, asking themselves questions after finishing with the task for making 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 report 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 their self-assessment abilities more than

females. Instead, males might be just less aware about their weaknesses and are therefore less able to identify them.

However, asking questions before beginning with the task (aspect D) is in the first sample reported weakest 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 about the significance and value of understanding the task for 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 have 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 if the 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 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, while almost all the students were undergraduates it is not surprising that the small amount of graduate students do not have sufficient power for appearing in this table.

The results of analysis have shown that the level of metacognitive awareness of 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 improvement of performance of students.

5. Conclusion & discussion

The aim of this paper was to search the ways to enhance the level of engineering students' metacompetencies thru entrepreneurship education courses.

Drawn from that, the theoretical framework provides an overview about how the metacompetencies of a person are approached in the frame of successful learning and employability in the labour market. In line with that, the research model of entrepreneurial and enterprising competences with the inclusion of metacompetences is developed to understand the frame of metacompetences for further research. With that, the focus of this research is turned more towards metacognition as an ability helping both to increase the performance in learning and to build a successful professional career in the future.

Empirical findings among the two samples shows that based on the study-levels, gender and groups of high- and low-achievers, the levels of metacognitive abilities are perceived significantly differently between students. In addition, the study helped to turn the focus to the statements that have been assessed weakest. Based on the analysis of the findings among the weakest aspects of metacognitive abilities, it is evident that a significant amount of students do not invest enough effort and energy into development of their knowledge and skills. Furthermore, it appears that the students lack the general analytical problem-solving skills, facilitating the success when facing novel tasks. With that the students also

consider the skills about 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 about how and why to assess their actions. Hence, the need to achieve and to purposefully act 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 in university. This being a result of the teaching and learning being excessively based on memorizing facts, i.e. surface learning approach. Hence, the abilities fostering the creative and independent (deep) learning, focusing on meaning of the content, is not sufficiently developed.

Still, it is evident that there is a potential to make an impact to all the components of metacognitive abilities with appropriately focused education. The weak aspects are available in both goal-setting skills, the skills related to using previous knowledge, make calculated steps and learning from each experience in order to be more successful in the future. Hence, by identifying the weak aspects of different groups of students, it is possible to develop the entrepreneurship education further by focusing more on the needs and weaknesses of the individual students. Consequently, weaknesses in metacognitive abilities of students can be fostered in entrepreneurship education by including more active learning methods, also to use learning strategies and create an environment, which motivate students to analyse deeply their tasks and to monitor and regulate their actions in the learning process. This would allow the students to advance the skills needed to independent solving of practical tasks, time-management, and essential team-working skills. Even more, active learning is likely to also contribute into the self-management and adaptability as necessary metacompetencies of every enterprising individual.

As a result, the students will develop the self-regulation and metacognition, addressing that the persons with higher level of metacognitive abilities are not necessarily working longer or harder but instead use the available resources more effectively. This means that students should have to learn skills for self-evaluating their strengths and weaknesses.

Following this, using the described teaching methodology and approach to successful learning, the self-assessment of students' abilities gives a basis for how to design the entrepreneurship education. Secondly, the current paper reveals the weaknesses in students metacognitive abilities, relating to goal-setting, using existing knowledge in the context of current tasks, choosing the most appropriate strategies in solving problems and monitoring the progress during this process.

6. Research limitations and ideas for future research

The limiting factors needing to take into account with this research include most importantly the aspect of applying the used measurement instrument for the first time in the university context. While the findings in general collaborate with the results of previous research retrieved with other instruments, it is still needed to be

aware which results the same instrument can give in other universities. Consequently, it is needed to apply the used MMA measurement instrument in a diverse and larger sample of students. With that, it is the belief of the authors that new, prospective and very interesting research-paths can be opened in the future connected with the need for

enhancing entrepreneurship education of engineering students for the development of their metacompetences, including metacognitive, meta-affective and metaconative competences according to the model presented in the article.

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ELULOOKIRJELDUS

1. Isikuandmed

Ees- ja perekonnanimi Hannes Ling
Sünniaeg ja -koht 25.06.1972, Tallinn
Kodakondsus Eesti
E-posti aadress hannesling@smail.ee

2. Hariduskäik

Õppeasutus (nimetus lõpetamise ajal)	Lõpetamise aeg	Haridus (eriala/kraad)
Tallinna Tehnikaülikool	2007	ärikorralduse magister / MBA
Tallinna Tehnikaülikool	2004	tehnikateaduste magister / MSc
Tallinna Tehnikaülikool	1997	inseneriõpe
Tallinna Polütehnikum	1991	kesk-eriharidus

3. Keelteoskus (alg-, kesk- või kõrgtase)

Keel	Tase
eesti	kõrgtase
inglise	kõrgtase
soome	kesktase
vene	kesktase
saksa	algtase

4. Täiendusõpe

Õppimise aeg	Täiendusõppe korraldaja nimetus
10/2010 – 12/2010	Teadusmetoodika: Teaduslik kirjutamine, TTÜ
04/2010 – 05/2010	Teadusmetoodika: Ankeetküsitluse planeerimine, TTÜ
03/2009	Teadusmetoodika: Kvantitatiivsed uurimismeetodid, TTÜ

5. Teenistuskäik

Töötamise aeg	Tööandja nimetus	Ametikoht
01/2008 – ...	TRÜB Baltic AS	projektijuht
04/1999 – 12/2007	Eesti Raudtee AS	projektijuht
01/1994 – 04/1999	Helmes AS	konsultant

6. Teadustegevus, sh tunnustused ja juhendatud lõputööd

Ling, H., Venesaar, U. (2014). Enhancing entrepreneurship education of engineering students for increasing their metacognitive abilities: analysis of students' self-assessments. *Engineering Economics* (ilmumas).

Ling, H. (2013). Impact of Entrepreneurship Education on Students' Metacognitive Awareness: Analysis Based on Students' Self-assessments. In G. Prause, U. Venesaar, & W. Kersten (Eds.), *International Business - Baltic Business Development* (pp. 265-289). Frankfurt am Main: Peter Lang GmbH.

Kristjuhan, K., Metsla, E., & Ling, H. (2013). Management capabilities and application of complex automated systems. *Estonian Journal of Engineering*, 19(1), 30–46.

Ling, H., Kyrö, P., & Venesaar, U. (2013). Entrepreneurship Education and Metacognitive Awareness: Development of a Tool to Measure Metacognitive Awareness. In A. Fayolle, P. Kyrö, T. Mets, & U. Venesaar. (Toim.), *Conceptual Richness and Methodological Diversity in Entrepreneurship Research: Entrepreneurship Research in Europe* (pp. 95-116). Cheltenham, UK: Edward Elgar Publishing

Kristjuhan, K., Metsla, E., & Ling, H. (2012). Quality of management practices and application of complex automated systems. In: Otto, T. (Ed.), *Proceedings of the 8th International Conference of DAAAM Baltic Industrial Engineering*, April 19-21 2012, Tallinn, Estonia (pp. 163-168). Tallinn: Tallinna Tehnikaülikooli Kirjastus.

Ling, H., Ustav, S., & Venesaar, U. (2012). Development of entrepreneurship education through enhancing metacognitive awareness of students. August 19-25, Kolding, Taani: Konverentsil ESU Conference on Entrepreneurship esitletud artikkel.

Ling, H., Leppiman, A., & Venesaar, U. (2011). Exploring metalearning in entrepreneurship education. In G. Prause, & U. Venesaar (Eds.),

University-Business Cooperation - Tallinn 2011 (pp. 114–134). Berlin: Berliner Wissenschafts-Verlag.

Ling, H., Liiv, I., Toding, M., & Venesaar, U. (2011). Metacognitive Awareness in the Frame of Entrepreneurial Profile of Students: A Case of Estonia. In: *Conference Proceedings of the ESU Conference on Entrepreneurship: Final Papers (CD-ROM)*, September 12-17, Seville, Spain.

Venesaar, U., Ling, H., & Voolaid, K. (2011). Evaluation of the Entrepreneurship Education Programme in University: A New Approach. *The Amfiteatru Economic Journal*, XIII(30), 377–391.

Pedas, K., Ling, H., & Venesaar, U. (2010). The Entrepreneurial Behaviour and Intentions of Students: A Case of Estonia. May 19-21, Kolding, Denmark: Konverentsil 16th Nordic Conference on Small Business Research esitletud artikkel.

Pedas, K., Ling, H., & Venesaar, U. (2010). Entrepreneurial Profile of Students and Motivations for their Career Choices. In: *Conference Proceedings of the ESU Conference on Entrepreneurship: Final Papers (CD-ROM)*, August 22-28, Tartu, Estonia.

Ling, H., Venesaar, U., & Voolaid, K. (2009). Assessing the Results of Entrepreneurship Training through Changes in Metacognitive Awareness of Participants. September 8-13, Benevento, Itaalia: Konverentsil ESU Conference on Entrepreneurship esitletud artikkel.

Tunnustused

Second Best Paper Award, artikli eest konverentsil *ESU Conference on Entrepreneurship*, August 22-28 (2010), Tartu, Eesti.

CURRICULUM VITAE

1. Personal data

Name Hannes Ling
Date and place of birth 25.06.1972, Tallinn
Citizenship Estonia
E-mail address hannesling@smail.ee

2. Education

Educational institution	Graduation year	Education (field of study/degree)
Tallinn University of Technology	2007	Business Administration / MBA
Tallinn University of Technology	2004	System Engineering / MSc
Tallinn University of Technology	1997	undergraduate studies
Tallinn Polytechnic School	1991	vocational education

3. Language competence/skills (fluent, average, basic skills)

Language	Level
Estonian	fluent
English	fluent
Finnish	average
Russian	average
German	basic skills

4. Special courses

Period	Educational or other organisation
10/2010 – 12/2010	Methodology: Scientific writing TUT
04/2010 – 05/2010	Methodology: Planning and designing of the questionnaire, TUT
03/2009	Methodology: Quantitative research methods, TUT

5. Professional employment

Period	Organisation	Position
01/2008 -...	TRÜB Baltic AS	project manager
04/1999 – 12/2007	Estonian Railways AS	project manager
01/1994 – 04/1999	Helmes AS	consultant

6. Research activity, including honours and thesis supervised

Ling, H., Venesaar, U. (2014). Enhancing entrepreneurship education of engineering students for increasing their metacognitive abilities: analysis of students' self-assessments. *Engineering Economics* (Forthcoming)

Ling, H. (2013). Impact of Entrepreneurship Education on Students' Metacognitive Awareness: Analysis Based on Students' Self-assessments. In G. Prause, U. Venesaar, & W. Kersten (Eds.), *International Business - Baltic Business Development* (pp. 265-289). Frankfurt am Main: Peter Lang GmbH.

Kristjuhan, K., Metsla, E., & Ling, H. (2013). Management capabilities and application of complex automated systems. *Estonian Journal of Engineering*, 19(1), 30–46.

Ling, H., Kyrö, P., & Venesaar, U. (2013). Entrepreneurship Education and Metacognitive Awareness: Development of a Tool to Measure Metacognitive Awareness. In A. Fayolle, P. Kyrö, T. Mets, & U. Venesaar. (Eds.), *Conceptual Richness and Methodological Diversity in Entrepreneurship Research: Entrepreneurship Research in Europe* (pp. 95-116). Cheltenham, UK: Edward Elgar Publishing.

Kristjuhan, K., Metsla, E., & Ling, H. (2012). Quality of management practices and application of complex automated systems. In: Otto, T. (Ed.), *Proceedings of the 8th International Conference of DAAAM Baltic Industrial Engineering*, April 19-21 2012, Tallinn, Estonia (pp. 163-168). Tallinn: Tallinna Tehnikaülikooli Kirjastus.

Ling, H., Ustav, S., & Venesaar, U. (2012). Development of entrepreneurship education through enhancing metacognitive awareness of students. August 19-25, Kolding, Denmark: Paper presented at ESU Conference on Entrepreneurship.

Ling, H., Leppiman, A., & Venesaar, U. (2011). Exploring metalearning in entrepreneurship education. In G. Prause, & U. Venesaar (Eds.),

University-Business Cooperation - Tallinn 2011 (pp. 114–134). Berlin: Berliner Wissenschafts-Verlag.

Ling, H., Liiv, I., Toding, M., & Venesaar, U. (2011). Metacognitive Awareness in the Frame of Entrepreneurial Profile of Students: A Case of Estonia. In: *Conference Proceedings of the ESU Conference on Entrepreneurship: Final Papers (CD-ROM)*, September 12-17, Seville, Spain.

Venesaar, U., Ling, H., & Voolaid, K. (2011). Evaluation of the Entrepreneurship Education Programme in University: A New Approach. *The Amfiteatru Economic Journal*, XIII(30), 377–391.

Pedas, K., Ling, H., & Venesaar, U. (2010). The Entrepreneurial Behaviour and Intentions of Students: A Case of Estonia. May 19-21, Kolding, Denmark: Paper presented at the 16th Nordic Conference on Small Business Research.

Pedas, K., Ling, H., & Venesaar, U. (2010). Entrepreneurial Profile of Students and Motivations for their Career Choices. In: *Conference Proceedings of the ESU Conference on Entrepreneurship: Final Papers (CD-ROM)*, August 22-28, Tartu, Estonia.

Ling, H., Venesaar, U., & Voolaid, K. (2009). Assessing the Results of Entrepreneurship Training through Changes in Metacognitive Awareness of Participants. September 8-13, Benevento, Italy: Paper presented at the ESU Conference on Entrepreneurship.

Honours

Second Best Paper Award, for the paper presented in *ESU Conference on Entrepreneurship*, August 22-28 (2010), Tartu, Estonia.

**DISSERTATIONS DEFENDED AT
TALLINN UNIVERSITY OF TECHNOLOGY ON
*ECONOMICS***

1. **August Aarma**. Segmented Analysis of Bank Customers and Banking Information: Estonian Case. 2001.
2. **Enn Listra**. The Development and Structure of Banking Sector: Retail Banking in Estonia. 2001.
3. **Tatyana Põlajeva**. The Comparative Analysis of Market's Attractiveness. 2001.
4. **Tuuli Tammeraid**. Modeling Flow of Funds for Estonia. 2002.
5. **Ivo Karilaid**. The Choice in General Method for Investment and Performance Evaluation. 2002.
6. **Hele Hammer**. Strategic Investment Decisions: Evidence from Survey and Field Research in Estonia. 2003.
7. **Viljar Jaamu**. The Methods and Instruments for Solving the Banking Crisis and Development of the Banking Sector in Estonia. 2003.
8. **Katri Kerem**. From Adoption to Relationships: Internet Banking in Estonia. 2003.
9. **Ly Kirikal**. Productivity, the Malmquist Index and the Empirical Study of Banks in Estonia. 2005.
10. **Jaanus Raim**. The PPP Deviations between Estonia and Non-Transitional Countries. 2006.
11. **Jochen Sebastian Heubischl**. European Network Governance – Corporate Network Systematic in Germany, the United Kingdom and France: an Empirical Investigation. 2006.
12. **Enno Lend**. Transpordiühenduse ja logistikasüsteemi interaktsioon (Saaremaa ja Hiiumaa näitel). 2007.
13. **Ivar Soone**. Interrelations between Retail Service Satisfaction and Customer Loyalty: A Holistic Perspective. 2007.
14. **Aaro Hazak**. Capital Structure and Dividend Decisions under Distributed Profit Taxation. 2008.
15. **Laivi Laidroo**. Public Announcements' Relevance, Quality and Determinants on Tallinn, Riga, and Vilnius Stock Exchanges. 2008.
16. **Martti Randveer**. Monetary Policy Transmission Channels, Flexibility of the Economy and Future Prospects of the Estonian Monetary System. 2009.

17. **Kaire Pöder**. Structural Solutions to Social Traps: Formal and Informal Institutions. 2010.
18. **Tõnn Talpsepp**. Investor Behavior and Volatility Asymmetry. 2010.
19. **Tarmo Kadak**. Creation of a Supportive Model for Designing and Improving the Performance Management System of an Organisation. 2011.
20. **Jüri Kleesmaa**. Economic Instruments as Tools for Environmental Regulation of Electricity Production in Estonia. 2011.
21. **Oliver Parts**. The Effects of Cosmopolitanism on Estonian and Slovenian Consumer Choice Behavior of Foreign *versus* Domestic Products. 2011.
22. **Mart Nutt**. Eesti parlamendi pädevuse kujunemine ja rakendamine välissuhetes. 2011.
23. **Igor Novikov**. Credit Risk Determinants in the Banking Sectors of the Baltic States. 2011.
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26. **Sirje Pädam**. Economic Perspectives on Environmental Policies: The Costs and Benefits of Environmental Regulation in Estonia. 2012.
27. **Juhan Värk**. Venemaa positiivse hõlvamise poliitika ja teiste välispoliitiliste liinide mõjud Eesti-Vene suhetele aastail 1991–2011. 2012.
28. **Mari Avarmaa**. Implications of Capital Structure and Credit Constraints for Company Performance: A Comparative Study of Local and Multinational Companies in the Baltics. 2012.
29. **Fabio Filipozzi**. The Efficiency of Interest Rate and Foreign Exchange Markets in the Euro Area and Central and Eastern Europe. 2012.
30. **Aleksei Netšunajev**. Developments and Determinants of Intra-Industry Trade in the Baltic States. 2012.
31. **Aleksandr Miina**. Critical Success Factors of Lean Thinking Implementation in Estonian Manufacturing Companies. 2012.
32. **Angelika Kallakmaa-Kapsta**. Before and After the Boom: Changes in the Estonian Housing Market. 2013.
33. **Karen Voolaid**. Measurement of Organizational Learning of Business Schools. 2013.
34. **Archil Chochia**. Models of European Integration: Georgia's Economic and Political Transition. 2013.